```
!pip install ultralytics==8.0.20
from IPython import display
display.clear output()
import ultralytics
ultralytics.checks()
Ultralytics YOLOv8.0.20 ₹ Python-3.10.6 torch-2.0.1+cu118 CUDA:0
(Tesla V100-SXM2-16GB, 16151MiB)
Setup complete ⊘ (2 CPUs, 12.7 GB RAM, 24.3/78.2 GB disk)
 !pip install roboflow
 from roboflow import Roboflow
 rf = Roboflow(api key="RrvrgjLPNrma5c1REwoU")
 project = rf.workspace("bangor-university").project("yolov8-lj3oc")
dataset = project.version(1).download("yolov8")
# tmr gul
Collecting roboflow
  Downloading roboflow-1.1.2-py3-none-any.whl (57 kB)
                                       57.4/57.4 kB 1.6 MB/s eta
0:00:00
 roboflow)
 Downloading certifi-2022.12.7-py3-none-any.whl (155 kB)
                                ----- 155.3/155.3 kB 6.7 MB/s eta
0:00:00
ent already satisfied: chardet==4.0.0 in
/usr/local/lib/python3.10/dist-packages (from roboflow) (4.0.0)
Collecting cycler==0.10.0 (from roboflow)
  Downloading cycler-0.10.0-py2.py3-none-any.whl (6.5 kB)
Collecting idna==2.10 (from roboflow)
 Downloading idna-2.10-py2.py3-none-any.whl (58 kB)
                                     --- 58.8/58.8 kB 8.6 MB/s eta
0:00:00
ent already satisfied: kiwisolver>=1.3.1 in
/usr/local/lib/python3.10/dist-packages (from roboflow) (1.4.4)
Requirement already satisfied: matplotlib in
/usr/local/lib/python3.10/dist-packages (from roboflow) (3.7.1)
Requirement already satisfied: numpy>=1.18.5 in
/usr/local/lib/python3.10/dist-packages (from roboflow) (1.22.4)
Requirement already satisfied: opency-python>=4.1.2 in
/usr/local/lib/python3.10/dist-packages (from roboflow) (4.7.0.72)
Requirement already satisfied: Pillow>=7.1.2 in
/usr/local/lib/python3.10/dist-packages (from roboflow) (8.4.0)
Collecting pyparsing==2.4.7 (from roboflow)
  Downloading pyparsing-2.4.7-py2.py3-none-any.whl (67 kB)
                                     --- 67.8/67.8 kB 9.1 MB/s eta
0:00:00
```

```
ent already satisfied: python-dateutil in
/usr/local/lib/python3.10/dist-packages (from roboflow) (2.8.2)
Collecting python-dotenv (from roboflow)
  Downloading python dotenv-1.0.0-py3-none-any.whl (19 kB)
Requirement already satisfied: requests in
/usr/local/lib/python3.10/dist-packages (from roboflow) (2.27.1)
Requirement already satisfied: six in /usr/local/lib/python3.10/dist-
packages (from roboflow) (1.16.0)
Collecting supervision (from roboflow)
  Downloading supervision-0.12.0-py3-none-any.whl (48 kB)
                                    --- 48.5/48.5 kB 7.0 MB/s eta
0:00:00
ent already satisfied: urllib3>=1.26.6 in
/usr/local/lib/python3.10/dist-packages (from roboflow) (1.26.16)
Collecting wget (from roboflow)
  Downloading wget-3.2.zip (10 kB)
  Preparing metadata (setup.py) ... ent already satisfied:
tqdm>=4.41.0 in /usr/local/lib/python3.10/dist-packages (from
roboflow) (4.65.0)
Requirement already satisfied: PyYAML>=5.3.1 in
/usr/local/lib/python3.10/dist-packages (from roboflow) (6.0.1)
Collecting requests-toolbelt (from roboflow)
  Downloading requests toolbelt-1.0.0-py2.py3-none-any.whl (54 kB)
                                      -- 54.5/54.5 kB 8.0 MB/s eta
0:00:00
ent already satisfied: contourpy>=1.0.1 in
/usr/local/lib/python3.10/dist-packages (from matplotlib->roboflow)
(1.1.0)
Requirement already satisfied: fonttools>=4.22.0 in
/usr/local/lib/python3.10/dist-packages (from matplotlib->roboflow)
(4.41.0)
Requirement already satisfied: packaging>=20.0 in
/usr/local/lib/python3.10/dist-packages (from matplotlib->roboflow)
(23.1)
Requirement already satisfied: charset-normalizer~=2.0.0 in
/usr/local/lib/python3.10/dist-packages (from requests->roboflow)
(2.0.12)
Requirement already satisfied: opency-python-
headless<5.0.0.0,>=4.8.0.74 in /usr/local/lib/python3.10/dist-packages
(from supervision->roboflow) (4.8.0.74)
Building wheels for collected packages: wget
  Building wheel for wget (setup.py) ... e=wget-3.2-py3-none-any.whl
size=9657
sha256=fc7aca9717fde732c83df62aa2a6592d3c1f4471f41d335451b10f4377eb0f2
  Stored in directory:
/root/.cache/pip/wheels/8b/f1/7f/5c94f0a7a505ca1c81cd1d9208ae2064675d9
7582078e6c769
Successfully built wget
```

```
Installing collected packages: wget, python-dotenv, pyparsing, idna,
cycler, certifi, supervision, requests-toolbelt, roboflow
  Attempting uninstall: pyparsing
    Found existing installation: pyparsing 3.1.0
    Uninstalling pyparsing-3.1.0:
      Successfully uninstalled pyparsing-3.1.0
  Attempting uninstall: idna
    Found existing installation: idna 3.4
    Uninstalling idna-3.4:
      Successfully uninstalled idna-3.4
 Attempting uninstall: cycler
    Found existing installation: cycler 0.11.0
    Uninstalling cycler-0.11.0:
      Successfully uninstalled cycler-0.11.0
  Attempting uninstall: certifi
    Found existing installation: certifi 2023.5.7
    Uninstalling certifi-2023.5.7:
      Successfully uninstalled certifi-2023.5.7
Successfully installed certifi-2022.12.7 cycler-0.10.0 idna-2.10
pyparsing-2.4.7 python-dotenv-1.0.0 requests-toolbelt-1.0.0 roboflow-
1.1.2 supervision-0.12.0 wget-3.2
{"pip_warning":{"packages":["certifi","cycler","idna","pyparsing"]}}
loading Roboflow workspace...
loading Roboflow project...
Dependency ultralytics==8.0.134 is required but found version=8.0.20,
to fix: `pip install ultralytics==8.0.134`
Downloading Dataset Version Zip in yolov8-1 to yolov8: 100% [1337743 /
1337743] bytes
Extracting Dataset Version Zip to yolov8-1 in yolov8:: 100%
        | 125/125 [00:00<00:00, 4364.59it/s]
!pip install ultralytics==8.0.20
from IPython import display
display.clear output()
import ultralytics
ultralytics.checks()
Ultralytics YOLOv8.0.20 ₹ Python-3.10.6 torch-2.0.1+cu118 CUDA:0
(Tesla V100-SXM2-16GB, 16151MiB)
Setup complete ⊘ (2 CPUs, 12.7 GB RAM, 24.3/78.2 GB disk)
from ultralytics import YOLO
from IPython.display import display, Image
```

```
%cd /content/volov8-1
!yolo task=detect mode=train model=yolov8s.pt data= '/content/yolov8-
1/data.yaml' epochs=10000 plots=True
/content/yolov8-1
Downloading
https://github.com/ultralytics/assets/releases/download/v0.0.0/yolov8s
.pt to yolov8s.pt...
100% 21.5M/21.5M [00:00<00:00, 166MB/s]
Ultralytics YOLOv8.0.20 ₹ Python-3.10.6 torch-2.0.1+cu118 CUDA:0
(Tesla V100-SXM2-16GB, 16151MiB)
volo/engine/trainer: task=detect, mode=train, model=volov8s.vaml,
data=/content/yolov8-1/data.yaml, epochs=10000, patience=50, batch=16,
imgsz=640, save=True, cache=False, device=, workers=8, project=None,
name=None, exist ok=False, pretrained=False, optimizer=SGD,
verbose=True, seed=0, deterministic=True, single cls=False,
image weights=False, rect=False, cos lr=False, close mosaic=10,
resume=False, overlap_mask=True, mask ratio=4, dropout=False,
val=True, save ison=False, save hybrid=False, conf=0.001, iou=0.7,
max det=300, half=False, dnn=False, plots=True,
source=ultralytics/assets/, show=False, save txt=False,
save conf=False, save crop=False, hide labels=False, hide conf=False,
vid stride=1, line thickness=3, visualize=False, augment=False,
agnostic nms=False, classes=None, retina masks=False, boxes=True,
format=torchscript, keras=False, optimize=False, int8=False,
dynamic=False, simplify=False, opset=17, workspace=4, nms=False,
lr0=0.01, lrf=0.01, momentum=0.937, weight decay=0.001,
warmup epochs=3.0, warmup momentum=0.8, warmup bias lr=0.1, box=7.5,
cls=0.5, dfl=1.5, fl gamma=0.0, label smoothing=0.0, nbs=64,
hsv h=0.015, hsv s=0.7, hsv v=0.4, degrees=0.0, translate=0.1,
scale=0.5, shear=0.0, perspective=0.0, flipud=0.0, fliplr=0.5,
mosaic=1.0, mixup=0.0, copy paste=0.0, cfg=None, v5loader=False,
save dir=runs/detect/train
Downloading https://ultralytics.com/assets/Arial.ttf to
/root/.config/Ultralytics/Arial.ttf...
100% 755k/755k [00:00<00:00, 17.1MB/s]
2023-07-25 20:41:55.288504: I
tensorflow/core/platform/cpu feature guard.cc:182] This TensorFlow
binary is optimized to use available CPU instructions in performance-
critical operations.
To enable the following instructions: AVX2 FMA, in other operations,
rebuild TensorFlow with the appropriate compiler flags.
2023-07-25 20:41:56.229400: W
tensorflow/compiler/tf2tensorrt/utils/py utils.cc:38] TF-TRT Warning:
Could not find TensorRT
Overriding model.yaml nc=80 with nc=3
                   from n
                              params
                                      module
```

```
arguments
                                        ultralytics.nn.modules.Conv
                      - 1
                                   928
  0
                          1
[3, 32, 3, 2]
                                 18560
                                        ultralytics.nn.modules.Conv
                      - 1
[32, 64, 3, 2]
                                 29056
                                        ultralytics.nn.modules.C2f
                      - 1
                          1
[64, 64, 1, True]
                                 73984
                                        ultralytics.nn.modules.Conv
                          1
                      - 1
[64, 128, 3, 2]
                      - 1
                          2
                                197632
                                        ultralytics.nn.modules.C2f
[128, 128, 2, True]
                      - 1
                          1
                                295424
                                        ultralytics.nn.modules.Conv
[128, 256, 3, 2]
                                788480
                                        ultralytics.nn.modules.C2f
                      -1 2
[256, 256, 2, True]
                                        ultralytics.nn.modules.Conv
                      -1 1
                               1180672
[256, 512, 3, 2]
                      -1 1
                               1838080
                                        ultralytics.nn.modules.C2f
[512, 512, 1, True]
                                        ultralytics.nn.modules.SPPF
                                656896
                      -1
                         1
[512, 512, 5]
                      - 1
                                                [None, 2, 'nearest']
torch.nn.modules.upsampling.Upsample
11
                 [-1, 6]
                                        ultralytics.nn.modules.Concat
[1]
12
                                        ultralytics.nn.modules.C2f
                      - 1
                                591360
[768, 256, 1]
                      - 1
                                                [None, 2, 'nearest']
torch.nn.modules.upsampling.Upsample
                                        ultralytics.nn.modules.Concat
14
                 [-1, 4]
[1]
                                        ultralytics.nn.modules.C2f
                                148224
15
                      - 1
[384, 128, 1]
                                147712
                                        ultralytics.nn.modules.Conv
                      -1
                          1
16
[128, 128, 3, 2]
17
                [-1, 12]
                          1
                                     0
                                        ultralytics.nn.modules.Concat
[1]
                                        ultralytics.nn.modules.C2f
18
                      -1
                          1
                               493056
[384, 256, 1]
                                        ultralytics.nn.modules.Conv
                                590336
19
                      - 1
                          1
[256, 256, 3, 2]
20
                 [-1, 9]
                          1
                                        ultralytics.nn.modules.Concat
[1]
                               1969152
                                        ultralytics.nn.modules.C2f
21
                      - 1
[768, 512, 1]
           [15, 18, 21]
                              2117209
                                        ultralytics.nn.modules.Detect
22
                          1
[3, [128, 256, 512]]
```

```
Model summary: 225 layers, 11136761 parameters, 11136745 gradients,
28.7 GFLOPs
Transferred 349/355 items from pretrained weights
optimizer: SGD(lr=0.01) with parameter groups 57 weight(decay=0.0), 64
weight(decay=0.001), 63 bias
train: Scanning /content/yolov8-1/train/labels... 52 images, 0
backgrounds, 0 corrupt: 100% 52/52 [00:00<00:00, 979.22it/s]
train: New cache created: /content/yolov8-1/train/labels.cache
albumentations: Blur(p=0.01, blur limit=(3, 7)), MedianBlur(p=0.01,
blur limit=(3, 7)), ToGray(p=0.01), CLAHE(p=0.01, clip limit=(1, 4.0),
tile grid size=(8, 8))
val: Scanning /content/yolov8-1/test/labels... 6 images, 0
backgrounds, 0 corrupt: 100% 6/6 [00:00<00:00, 1111.32it/s]
val: New cache created: /content/yolov8-1/test/labels.cache
Image sizes 640 train, 640 val
Using 2 dataloader workers
Logging results to runs/detect/train
Starting training for 10000 epochs...
      Epoch
               GPU mem
                         box loss cls loss dfl loss Instances
Size
    1/10000
                 4.37G
                            2.303
                                       4.713
                                                 0.9862
                                                                 65
640: 100% 4/4 [00:15<00:00,
                             3.93s/itl
/usr/local/lib/python3.10/dist-packages/torch/optim/lr scheduler.py:13
9: UserWarning: Detected call of `lr scheduler.step()` before
`optimizer.step()`. In PyTorch 1.1.0 and later, you should call them
in the opposite order: `optimizer.step()` before
`lr scheduler.step()`. Failure to do this will result in PyTorch
skipping the first value of the learning rate schedule. See more
details at https://pytorch.org/docs/stable/optim.html#how-to-adjust-
learning-rate
  warnings.warn("Detected call of `lr scheduler.step()` before
`optimizer.step()`. "
                 Class
                           Images Instances
                                                                 R
                                                  Box (P
mAP50
      mAP50-95): 100% 1/1 [00:03<00:00,
                                          3.95s/itl
                   all
                                6
                                         100
                                                0.00475
                                                            0.0476
0.00936
           0.00446
                                                                  0
            microcrack
0
                                           8
                                                                  0
              porosity
     unmelted particle
                                6
                                          91
                                                 0.0142
                                                             0.143
0.0281
           0.0134
      Epoch
               GPU mem
                         box loss cls loss
                                               dfl loss Instances
Size
    2/10000
                 4.96G
                            2.308
                                       4.638
                                                  1.029
                                                                 70
640: 100% 4/4 [00:07<00:00,
                             1.78s/itl
                           Images Instances
                                                                 R
                 Class
                                                  Box(P
```

mAP50 mAP50-	-95): 100% all			llit/s] 0.00368	0.0366
	0.0036 microcrack	6	1	0	0
	porosity	6	8	0	0
0 0 unmelted 0.0232 0	d particle	6	91	0.011	0.11
Epoch Size	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
				1.006	39
mAP50 mAP50-	Class -95): 100%	Images 1/1 [00:00<	Instances 00:00, 4.6	Box(P 62it/s] 0.174	R 0.122
0.129 0.	. 109	-			
0 0			1	0	0
0.344 0.	porosity .309	6	8	0.5	0.125
unmelted 0.0432		6	91	0.0235	0.242
Epoch Size	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
4/10000 640: 100% 4/4	5.71G 4 [00:08<00	2.022 :00, 2.11s	2.895 /it]	0.9505	107
mAP50 mAP50	Class -95): 100%	Images	Instances 00:00, 4.4	Box(P 7it/s] 0.577	
0.364 0.	. 173			0.377	
0 0			1		0
0.576 0	porosity .358	6	8	1	0.25
	d particle .162	6	91	0.731	0.479
Epoch Size	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
5/10000 640: 100% 4/4	5.71G 4 [00:07<00	2.16 :00, 1.81s	2.342 /it]	0.9586	45
mAP50 mAP50-	Class	Images	Instances		R
	all .117	6	100	0.724	0.23
	microcrack	6	1	1	0

U 338	0.22	oorosity	(5 8	0.473	0.25
uı	nmelted p	particle	(91	0.699	0.44
0.458	0.12	28				
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 6/3	10000	5.71G	2.003	3 2.068	0.9292	38
		[00:08<00):00, 2.19	s/it]		
mAP50	mAP50-95	5): 100%	1/1 [00:00	s instances 0<00:00, 4.	Box(P 40it/s]	R
	0.134	all	(0.264	0.165
0.25			(5 1	0	0
0	0	oorosity	Ĺ	5 8	0.157	0.375
	0.24					
	nmelted p 0.1		(91	0.635	0.121
Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
7/:					0.9618	157
640: 10	00% 4/4		0:00, 2.17 Images		Box(P	R
mAP50	mAP50-95	5): 100%	1/1 [00:00	0<00:00, 4.	46it/s]	
0.265	0.13		(5 100	0.701	0.246
0	mio O	crocrack	(5 1	1	0
	F	oorosity	(5 8	0.537	0.375
_	0.27 nmelted ہ	_	(S 01	0.564	0.363
	0.1		,) 91	0.504	0.505
	Epoch	GPU mem	box loss	cls loss	dfl loss	Instances
Size	•	_	_	_	_	
8/. 640: 10	10000 00% 4/4	5.71G 00:07<00]	2.079 1.82] 1.699 [s/it]	0.9291	103
		Class	Images	Instances	Box(P	R
mAP50	IIIAPSU-93	all		0<00:00, 4. 5 100		0.217
0.245	0.13	34 crocrack	(5 1	1	0
Θ	0	CIUCIACK				
0 442	0.32	oorosity 28	(5 8	0.946	0.375
uı	nmelted p	particle	(91	0.465	0.275
0.293	0.073	33				

	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 9,	/10000	5.71G	1.867	1.728	0.9119	72
640: 1	100% 4/4	[00:08<00 Class	:00, 2.15s	s/it] Instances	Box(P	R
mAP50	mAP50-9	5): 100%	1/1 [00:00<	<00:00, 4.5	0.893	
0.364	e	1.2				0
0	0					
0.505	0.3	porosity 379			0.965	
	unmelted 0.2	particle 222	6	91	0.715	0.473
Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
10,					0.9169	105
		Class		Instances	Box(P	R
mAP50	mAP50-9	05): 100% all		<00:00, 3.2 100	24it/s] 0.821	0.274
0.306	0.1 mi	.52 .crocrack	6	1	1	Θ
0	0			8	0.923	0.5
	0.3	868				
	0.08	particle 69	6	91	0.539	0.321
Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
11,			2.162 :00, 1.81s		0.9397	87
		Class	Images	Instances	Box(P	R
mAP50		all	1/1 [00:00< 6	<00:00, 4.7 100	0.857	0.322
0.382	0.1 mi	.78 .crocrack	6	1	1	0
Θ	Θ	porosity	6	8	1	0.469
0.649	0.3 unmelted		6	91	0.57	0.496
0.498		14	J	31	0137	01.130
Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
12,				1.579	0.9014	92
040: .	LUU% 4/4	[00:09<00 Class	:00, 2.26s Images		Box(P	R

mAP50		100% all	1/1 [00:00<		51it/s] 0.762	0.351
0.378	0.203					
0	micro 0	crack	6	1	1	0
0.641	por 0.44	osity	6	8	0.649	0.625
ur	nmelted par 0.169	ticle	6	91	0.637	0.429
Size	Epoch GF	PU_mem	box_loss	cls_loss	dfl_loss	Instances
13/1	90% 4/4 [00	00>80:	:00, 2.02s	/it]	0.9202	
mAP50	mAP50-95):	100%	1/1 [00:00<	00:00, 3.0		
0.319	0.181	all	6	100	0.774	0.285
Θ	micro 0	crack	6	1	1	0
	por	osity	6	8	1	0.592
ur	0.464 nmelted par 0.0807	ticle	6	91	0.323	0.264
	Enoch GE	Oll mam	hov loce	cle loce	dfl locc	Instances
Size		_	_	_	dfl_loss	
Size 14/1	10000 90% 4/4 [00	6.74G 0:07<00	2.186 :00, 1.82s	1.492 /it]	0.9232	63
Size 14/1 640: 10	10000 00% 4/4 [00 mAP50-95):	6.74G 0:07<00 Class 100%	2.186 :00, 1.82s Images 1/1 [00:00<	1.492 /it] Instances 00:00, 4.5	0.9232 Box(P	63 R
Size 14/1 640: 10 mAP50	10000 00% 4/4 [00 mAP50-95):	6.74G 0:07<00 Class 100%	2.186 :00, 1.82s Images 1/1 [00:00< 6	1.492 /it] Instances 00:00, 4.5 100	0.9232 Box(P 66it/s] 0.776	63 R
Size 14/1 640: 16 mAP50 0.574	10000 90% 4/4 [00 mAP50-95): 0.284 micro	6.74G 0:07<00 Class 100% all	2.186 :00, 1.82s Images 1/1 [00:00<	1.492 /it] Instances 00:00, 4.5	0.9232 Box(P	63 R
Size 14/1 640: 10 mAP50 0.574 0.497	10000 90% 4/4 [00 mAP50-95): 0.284 micro 0.149 por	6.74G 0:07<00 Class 100% all	2.186 :00, 1.82s Images 1/1 [00:00< 6	1.492 /it] Instances 00:00, 4.5 100	0.9232 Box(P 66it/s] 0.776	63 R 0.355
Size 14/1 640: 16 mAP50 0.574 0.497 0.69	10000 00% 4/4 [00 mAP50-95): 0.284 micro 0.149 por 0.475 nmelted par	6.74G 0:07<00 Class 100% all ocrack	2.186 :00, 1.82s Images 1/1 [00:00< 6	1.492 /it] Instances 00:00, 4.5 100	0.9232 Box(P 66it/s] 0.776	63 R 0.355 0 0.625
Size 14/1 640: 16 mAP50 0.574 0.497 0.69 ur 0.534	10000 90% 4/4 [00 mAP50-95): 0.284 micro 0.149 por 0.475 nmelted par 0.228	6.74G 0:07<00 Class 100% all ocrack Tosity	2.186 :00, 1.82s Images 1/1 [00:00< 6 6	1.492 /it] Instances 00:00, 4.5 100 1	0.9232 Box(P 66it/s] 0.776 1 0.684	63 R 0.355 0 0.625
Size 14/1 640: 16 mAP50 0.574 0.497 0.69 ur 0.534 Size 15/1	10000 90% 4/4 [06 mAP50-95): 0.284 micro 0.149 por 0.475 nmelted par 0.228 Epoch GF	6.74G 0:07<00 Class 100% all ocrack cosity cticle PU_mem 6.74G	2.186 :00, 1.82s Images 1/1 [00:00< 6 6 6 6 6 box_loss	1.492 /it] Instances 00:00, 4.5 100 1 8 91 cls_loss 1.386	0.9232 Box(P 66it/s] 0.776 1 0.684 0.645 dfl_loss	63 R 0.355 0 0.625
Size 14/1 640: 16 mAP50 0.574 0.497 0.69 ur 0.534 E Size 15/1 640: 16	10000 90% 4/4 [00 mAP50-95): 0.284 micro 0.149 por 0.475 nmelted par 0.228 Epoch GF	6.74G 0:07<00 Class 100% all ocrack cosity cticle PU_mem 6.74G 0:09<00 Class	2.186 :00, 1.82s Images 1/1 [00:00< 6 6 6 6 box_loss 1.951 :00, 2.30s Images	1.492 /it] Instances 00:00, 4.5 100 1 8 91 cls_loss 1.386 /it] Instances	0.9232 Box(P 66it/s] 0.776 1 0.684 0.645 dfl_loss 0.9068 Box(P	63 R 0.355 0 0.625 0.44 Instances
Size 14/1 640: 16 mAP50 0.574 0.497 0.69 ur 0.534 E Size 15/1 640: 16	10000 90% 4/4 [00 mAP50-95): 0.284 micro 0.149 por 0.475 nmelted par 0.228 Epoch GF	6.74G 0:07<00 Class 100% all ocrack cosity cticle PU_mem 6.74G 0:09<00 Class	2.186 :00, 1.82s Images 1/1 [00:00< 6 6 6 6 box_loss 1.951 :00, 2.30s	1.492 /it] Instances 00:00, 4.5 100 1 8 91 cls_loss 1.386 /it] Instances	0.9232 Box(P 66it/s] 0.776 1 0.684 0.645 dfl_loss 0.9068 Box(P	63 R 0.355 0 0.625 0.44 Instances 68
Size 14/1 640: 16 mAP50 0.574 0.497 0.69 ur 0.534 E Size 15/1 640: 16	10000 90% 4/4 [06 mAP50-95): 0.284 micro 0.149 por 0.475 mmelted par 0.228 Epoch GF 10000 90% 4/4 [06 mAP50-95): 0.243 micro	6.74G 0:07<00 Class 100% all ocrack cosity cticle PU_mem 6.74G 0:09<00 Class 100%	2.186 :00, 1.82s Images 1/1 [00:00< 6 6 6 6 box_loss 1.951 :00, 2.30s Images 1/1 [00:00<	1.492 /it] Instances 00:00, 4.5 100 1 8 91 cls_loss 1.386 /it] Instances 00:00, 4.4	0.9232 Box(P 66it/s] 0.776 1 0.684 0.645 dfl_loss 0.9068 Box(P	63 R 0.355 0 0.625 0.44 Instances 68 R

0 676	porosity 0.47	6	8	0.585	0.625
un	melted particle	6	91	0.771	0.334
0.572	0.216				
E Size	poch GPU_mem	box_loss	cls_loss	dfl_loss	Instances
16/1	0000 6.74G			0.8835	82
640: 10	0% 4/4 [00:07<00 Class	9:00, 1.969 Images	Instances	Box(P	R
mAP50	mAP50-95): 100%	1/1 [00:00<	<00:00, 3.2		
0.399	0.186				
0	microcrack 0	6	1	1	0
0.766	porosity 0.423	6	8	1	0.59
un	melted particle	6	91	0.42	0.637
0.432	0.135				
E Size	poch GPU_mem	box_loss	cls_loss	dfl_loss	Instances
17/1	0000 6.74G	1.99	1.356	0.9011	104
640: 10	0% 4/4 [00:07<00 Class	9:00, 1.91s Images	s/it] Instances	Box(P	R
mAP50	mAP50-95): 100% all	1/1 [00:00<	<00:00, 4.7		
0.434	0.243				
0	microcrack 0	6	1	1	0
0.765	porosity 0.518	6	8	0.749	0.75
un	melted particle	6	91	0.723	0.459
0.537	0.211				
E Size	poch GPU_mem	box_loss	cls_loss	dfl_loss	Instances
18/1	0000 6.74G	2.155	1.503	0.98	36
640: 10	0% 4/4 [00:08<00 Class			Box(P	R
mAP50	mAP50-95): 100% all		<00:00, 4.5	52it/s]	
0.374	0.223				
0.0262	microcrack 0.0168	6	1	1	0
0.79	porosity 0.536	6	8	0.682	0.75
un	melted particle	6	91	0.483	0.286
0.305	0.116				

	Epoch	GPU mem	box loss	cls loss	dfl_loss	Instances
Size		_	_	_	_	
19/ 640: 1	10000 00% 4/4	6.74G [00:07<00	2.214 :00, 1.90s	1.452 5/itl	0.9462	45
		Class	Images	Instances	Box (P	R
mAP50	MAP50-9	95): 100% all	1/1 [00:00< 6	00:00, 2.9 100	0.804	0.41
0.435	0.2	234				
0.0711	0.0	9355	6	1	1	0
	0.	porosity	6	8	0.594	0.733
		particle	6	91	0.819	0.497
0.636	0.2	248				
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 20/	10000	6.74G	2.2	1,602	0.9352	56
640: 1	00% 4/4	[00:07<00	:00, 1.82s	s/it]		
mAP50	mAP50-9	Class 95): 100%	Images 1/1 [00:00<	Instances 00:00, 4.8	Box(P B0it/s]	R
		all	6	100	0.715	0.233
0.287		l81 icrocrack	6	1	1	Θ
0	0				0.819	0 5
0.654	0.4		6	ō	0.819	0.5
	nmelted 0.06	particle	6	91	0.324	0.198
Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
21/					0.9561	55
640: 1	00% 4/4	[00:09<00 Class	:00, 2.25s	s/it] Instances	Box (P	R
mAP50	mAP50-9	95): 100%	1/1 [00:00<	<00:00, 4.6	33it/s]	
0.324	0.1	all 184	6	100	0.56	0.364
	mi	icrocrack	6	1	1	0
0	0	porosity	6	8	0.209	0.75
0.643	0.4	148	C			0. 242
0.328	nmetted 0.1	particle 105	6	91	0.471	0.342
	Epoch	GPU mem	box loss	cls loss	dfl loss	Instances
Size	•	_	_	_	_	58
	10000 00% 4/4	7.83G [00:07<00	2.096 :00, 1.94s		0.9032	30
		Class	Images	Instances	Box (P	R

mAP50		5): 100% all	1/1 [00:00<		12it/s] 0.773	0.394
0.424	0.22	24				
0 166	mic 0.049	rocrack	6	1	1	0
0.100		orosity	6	8	0.948	0.625
	0.501		C	0.1	0.27	0 556
	nmelted p 0.12		6	91	0.37	0.556
Size		_	-	_	dfl_loss	Instances
		00:07<00	:00, 1.91s	/it]	0.9376	86
mAP50	mAP50-95	5): 100%	1/1 [00:00<	00:00, 4.7		
0.435	0.19		0	100	0.837	0.377
		rocrack	6	1	1	0
	р	orosity	6	8	0.839	0.75
	0.39		6	91	0.671	0.381
	0.18		-			
Size		_	_	_	dfl_loss	
Size 24/	10000	7.83G 00:08<00	1.992 :00, 2.17s	1.556 /it]	0.9541	59
Size 24/ 640: 1	10000 00% 4/4 [mAP50-95	7.83G 00:08<00 Class 5): 100%	1.992 :00, 2.17s Images 1/1 [00:00<	1.556 /it] Instances 00:00, 4.4	0.9541 Box(P 14it/s]	59 R
Size 24/ 640: 1 mAP50	10000 00% 4/4 [mAP50-95	7.83G 00:08<00 Class 5): 100% all	1.992 :00, 2.17s Images 1/1 [00:00<	1.556 /it] Instances 00:00, 4.4	0.9541 Box(P	59 R
Size 24/ 640: 1 mAP50 0.355	10000 00% 4/4 [mAP50-95 0.19 mic	7.83G 00:08<00 Class 5): 100% all 1	1.992 :00, 2.17s Images 1/1 [00:00< 6	1.556 /it] Instances 00:00, 4.4	0.9541 Box(P 14it/s]	59 R
Size 24/ 640: 1 mAP50	10000 00% 4/4 [mAP50-95 0.19 mic 0	7.83G 00:08<00 Class 5): 100% all 1	1.992 :00, 2.17s Images 1/1 [00:00< 6	1.556 /it] Instances 00:00, 4.4 100	0.9541 Box(P 44it/s] 0.767	59 R 0.355 0
Size 24/ 640: 1 mAP50 0.355 0	10000 00% 4/4 [mAP50-95 0.19 mic 0 p	7.83G 00:08<00 Class 5): 100% all crocrack	1.992 :00, 2.17s Images 1/1 [00:00< 6	1.556 /it] Instances 00:00, 4.4 100	0.9541 Box(P 44it/s] 0.767 1 0.561	59 R 0.355 0 0.75
Size 24/ 640: 1 mAP50 0.355 0	10000 00% 4/4 [mAP50-95 0.19 mic 0 p 0.435 nmelted p	7.83G 00:08<00 Class 5): 100% all crocrack corosity	1.992 :00, 2.17s Images 1/1 [00:00< 6	1.556 /it] Instances 00:00, 4.4 100	0.9541 Box(P 44it/s] 0.767 1 0.561	59 R 0.355 0 0.75
Size 24/ 640: 1 mAP50 0.355 0 0.67 u	10000 00% 4/4 [mAP50-95 0.19 mic 0 p 0.435 nmelted p 0.13	7.83G 00:08<00 Class 5): 100% all crocrack corosity particle	1.992 1.90, 2.17s Images 1/1 [00:00< 6 6	1.556 /it] Instances :00:00, 4.4 100 1	0.9541 Box(P 44it/s] 0.767 1 0.561	59 R 0.355 0 0.75 0.314
Size 24/ 640: 1 mAP50 0.355 0 0.67 u 0.394 Size 25/	10000 00% 4/4 [mAP50-95 0.19 mic 0 p 0.435 nmelted p 0.13 Epoch	7.83G 00:08<00 Class 5): 100% all crocrack corosity barticle 8 GPU_mem 7.83G 00:07<00	1.992 1:00, 2.17s Images 1/1 [00:00< 6 6 6 6 box_loss 2.293 1:00, 1.82s	1.556 /it] Instances :00:00, 4.4 100 1 8 91 cls_loss 3.915 /it]	0.9541 Box(P 44it/s] 0.767 1 0.561 0.741 dfl_loss 0.9859	59 R 0.355 0 0.75 0.314
Size 24/ 640: 1 mAP50 0.355 0 0.67 u 0.394 Size 25/ 640: 1	10000 00% 4/4 [mAP50-95 0.19 mic 0 p 0.435 nmelted p 0.13 Epoch	7.83G 00:08<00 Class 5): 100% all crocrack corosity article 8 GPU_mem 7.83G 00:07<00 Class	1.992 :00, 2.17s Images 1/1 [00:00< 6 6 6 6 box_loss 2.293 :00, 1.82s Images	1.556 /it] Instances :00:00, 4.4 100 1 8 91 cls_loss 3.915 /it] Instances	0.9541 Box(P 44it/s] 0.767 1 0.561 0.741 dfl_loss 0.9859 Box(P	59 R 0.355 0 0.75 0.314 Instances
Size 24/ 640: 1 mAP50 0.355 0 0.67 u 0.394 Size 25/ 640: 1	10000 00% 4/4 [mAP50-95 0.19 mic 0 p 0.435 nmelted p 0.13 Epoch	7.83G 00:08<00 Class 5): 100% all crocrack corosity article 8 GPU_mem 7.83G 00:07<00 Class	1.992 1:00, 2.17s Images 1/1 [00:00< 6 6 6 6 box_loss 2.293 1:00, 1.82s	1.556 /it] Instances :00:00, 4.4 100 1 8 91 cls_loss 3.915 /it] Instances	0.9541 Box(P 44it/s] 0.767 1 0.561 0.741 dfl_loss 0.9859 Box(P	59 R 0.355 0 0.75 0.314 Instances
Size 24/ 640: 1 mAP50 0.355 0 0.67 u 0.394 Size 25/ 640: 1	10000 00% 4/4 [mAP50-95 0.19 mic 0 p 0.435 nmelted p 0.13 Epoch 10000 00% 4/4 [mAP50-95	7.83G 00:08<00 Class 5): 100% all crocrack corosity barticle 8 GPU_mem 7.83G 00:07<00 Class 5): 100% all	1.992 1:00, 2.17s Images 1/1 [00:00< 6 6 6 6 6 box_loss 2.293 1:00, 1.82s Images 1/1 [00:00< 6	1.556 /it] Instances :00:00, 4.4 100 1 8 91 cls_loss 3.915 /it] Instances :00:00, 4.4 100	0.9541 Box(P 44it/s] 0.767 1 0.561 0.741 dfl_loss 0.9859 Box(P 43it/s] 0.904	59 R 0.355 0 0.75 0.314 Instances 119 R 0.289
Size 24/ 640: 1 mAP50 0.355 0 0.67 0.394 Size 25/ 640: 1 mAP50	10000 00% 4/4 [mAP50-95 0.19 mic 0 p 0.435 nmelted p 0.13 Epoch 10000 00% 4/4 [mAP50-95	7.83G 00:08<00 Class 5): 100% all crocrack corosity carticle 8 GPU_mem 7.83G 00:07<00 Class 5): 100% all	1.992 1:00, 2.17s Images 1/1 [00:00< 6 6 6 6 box_loss 2.293 1:00, 1.82s Images 1/1 [00:00<	1.556 /it] Instances 00:00, 4.4 100 1 8 91 cls_loss 3.915 /it] Instances 00:00, 4.4	0.9541 Box(P 44it/s] 0.767 1 0.561 0.741 dfl_loss 0.9859 Box(P 43it/s]	59 R 0.355 0 0.75 0.314 Instances 119 R

0.676	Θ.	porosity	6	8	0.854	0.735
		particle	6	91	0.858	0.133
0.368	0.3	131				
	poch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 26/1	0000	7.83G	2.242	1.882	0.9672	132
		[00:08<00	0:00, 2.11	s/it]		
mAP50	mAP50-9			Instances <00:00, 4.8		R
		all			0.762	0.386
0.346		203 icrocrack	6	1	1	0
0	0					
0.644		porosity 472	6	8	0.663	0.75
un	melted	particle	6	91	0.623	0.407
0.394	0.1	136				
	poch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 27/1	.0000	7.83G	2.162	1.734	0.9455	89
640: 10	0% 4/4			s/it]	D / D	D
mAP50	mAP50-9			Instances <00:00, 4.5		R
		all			0.64	0.333
0.648		icrocrack	6	1	1	0
0.995	0.3		c	0	0.266	0.75
0.644		porosity 456	6	8	0.266	0.75
		particle	6	91	0.655	0.25
0.304						
Size E	poch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
28/1				1.991	0.9516	81
640: 10	0% 4/4	_):00, 1.80: Tmages	s/it] Instances	Roy (P	R
mAP50	mAP50-9	95): 100%		<00:00, 4.5	53it/s]	
0.408	ο .	all 192	6	100	0.711	0.356
	m:	icrocrack	6	1	1	0
0.199	0.04	443 porosity	6	8	0.384	0.75
0.697		426				
un 0.328		particle 104	6	91	0.749	0.319
31320	01.	'				

	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size	10000	7 83G	2 293	1 413	0.9769	58
		[00:08<00	:00, 2.049	s/it]		
mAD50	mΛD5Ω_0	Class	Images	Instances 4.4 oo:00,	Box(P	R
		all	6	100	0.852	0.325
0.354		.18	6	1	1	0
Θ	0					
0 735	0.4	porosity	6	8	1	0.616
u	nmelted	particle	6	91	0.557	0.359
0.327	0.1	119				
Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
	10000	7.83G	2.131	1.648	0.9865	77
		[00:08<00	:00, 2.119	s/it]		
mAP50	mAP50-9	95): 100%	1/1 [00:00<	<00:00, 4.7	Box(P 78it/s]	R
	0.19	all	6	100	0.758	0.356
0.42			6	1	1	0
0.142	0.04		6	0	0 446	0.75
0.68	0.40	porosity 92	6	8	0.446	0.75
		particle	6	91	0.828	0.317
0.439	0	. 15				
Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
31/	10000	7.83G	1.936	1.73	0.9228	56
640: 1	00% 4/4	[00:07<00	:00, 1.889	s/it]	Box(P	D
mAP50	mAP50-9			<00:00, 4.6		ĸ
0.240	0.1	all	6	100	0.777	0.296
0.348		icrocrack	6	1	1	0
0.111	0.02		6	0	0.754	0.625
0.652	0.3	porosity 383	6	8	0.754	0.625
u 0.283		particle 103	6	91	0.577	0.264
	Fnoch	GPU mem	box loss	cls loss	dfl loss	Instances
Size	•	_	_	_	_	
	10000	7.83G	2.151 :00, 2.23s	1.292 s/i+1	0.944	70
3101 1		Class	Images		Box(P	R

mAP50 r	mAP50-95)	: 100% all	1/1 [00:00<		0.798	0.358
0.554	0.224		6	1	1	0
0.497	micro 0.0995	ocrack				
0.646	po: 0.383	rosity	6	8	0.563	0.75
unr	melted par 0.189	rticle	6	91	0.831	0.324
Ep Size	ooch GI	PU_mem	box_loss	cls_loss	dfl_loss	Instances
33/10			2.08 0:00, 2.18s		0.9406	
mAP50 r	mAP50-95)	: 100%	1/1 [00:00<	(00:00, 4.4	Box(P 40it/s]	
0.277	0.155		6	100	0.76	0.309
0	micro		6	1	1	0
	po	rosity	6	8	0.682	0.75
unr	0.395 nelted pa 0.0691	rticle	6	91	0.597	0.176
0.207	0.0091					
Ep Size	ooch GI	PU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 34/10	9000	7.83G	2.202	1.301	dfl_loss 0.9586	
Size 34/10 640: 100	9000 9% 4/4 [00	7.83G 0:07<00 Class	2.202 0:00, 1.81s	1.301 s/it] Instances	0.9586 Box(P	59
Size 34/10 640: 100 mAP50 r	0000 0% 4/4 [00 nAP50-95)	7.83G 9:07<00 Class : 100% all	2.202 0:00, 1.81s Images	1.301 [/it] Instances [00:00, 4.5]	0.9586 Box(P 53it/s]	59 R
34/10 640: 100 mAP50 r	0000 0% 4/4 [00 nAP50-95) 0.243 micro	7.83G 0:07<00 Class : 100% all	2.202 0:00, 1.81s Images 1/1 [00:00< 6	1.301 [/it] Instances [00:00, 4.5]	0.9586 Box(P 53it/s]	59 R
34/10 640: 100 mAP50 r	0000 0% 4/4 [00 mAP50-95) 0.243 micro 0.149	7.83G 0:07<00 Class : 100% all	2.202 0:00, 1.81s Images 1/1 [00:00< 6	1.301 [/it] Instances 100:00, 4.5	0.9586 Box(P 53it/s] 0.8	59 R 0.389
34/10 640: 100 mAP50 r 0.528 0.497 0.653	0000 0% 4/4 [00 nAP50-95) 0.243 micro 0.149 por	7.83G 0:07<00 Class : 100% all ocrack	2.202 0:00, 1.81s Images 1/1 [00:00< 6	1.301 [instances] [instances]	0.9586 Box(P 53it/s] 0.8 1 0.725	59 R 0.389 0
34/10 640: 100 mAP50 r 0.528 0.497 0.653	0000 0% 4/4 [00 nAP50-95) 0.243 micro 0.149 por 0.465 melted par	7.83G 0:07<00 Class : 100% all ocrack	2.202 0:00, 1.81s Images 1/1 [00:00< 6	1.301 [instances] [instances]	0.9586 Box(P 53it/s] 0.8	59 R 0.389 0
34/10 640: 100 mAP50 r 0.528 0.497 0.653 unr 0.435	0000 0% 4/4 [00 nAP50-95) 0.243 micro 0.149 por 0.465 nelted par	7.83G 0:07<00 Class : 100% all ocrack rosity	2.202 0:00, 1.81s Images 1/1 [00:00< 6 6	1.301 [instances] [instances]	0.9586 Box(P 53it/s] 0.8 1 0.725	59 R 0.389 0 0.75
Size 34/10 640: 100 mAP50 r 0.528 0.497 0.653 unr 0.435 Eg Size 35/10	0000 0% 4/4 [00 0.243 micro 0.149 0.465 nelted part 0.115 0000	7.83G 9:07<00 Class 100% all ccrack rosity rticle PU_mem 7.83G	2.202 0:00, 1.81s Images 1/1 [00:00< 6 6 6 6 6 box_loss 2.375	1.301 [/it] Instances :00:00, 4.5 100 1 8 91 cls_loss 1.316	0.9586 Box(P 53it/s] 0.8 1 0.725 0.675 dfl_loss	59 R 0.389 0 0.75
Size 34/10 640: 100 mAP50 r 0.528 0.497 0.653 unr 0.435 Eg Size 35/10 640: 100	0000 % 4/4 [00] 0.243 micro 0.149 0.465 melted para 0.115 0000 0% 4/4 [00]	7.83G 0:07<00 Class 100% all ocrack rosity rticle 7.83G 0:08<00 Class	2.202 0:00, 1.81s Images 1/1 [00:00< 6 6 6 6 box_loss 2.375 0:00, 2.16s Images	1.301 s/it] Instances s00:00, 4.5 100 1 8 91 cls_loss 1.316 s/it] Instances	0.9586 Box(P 53it/s] 0.8 1 0.725 0.675 dfl_loss 1.031 Box(P	59 R 0.389 0 0.75 0.418 Instances
Size 34/10 640: 100 mAP50 r 0.528 0.497 0.653 unr 0.435 Eg Size 35/10 640: 100 mAP50 r	0000 0% 4/4 [000 0.243 micro 0.149 0.465 melted part 0.115 0000 0% 4/4 [000 0mAP50-95)	7.83G 0:07<00 Class 100% all ocrack rosity rticle 7.83G 0:08<00 Class	2.202 0:00, 1.81s Images 1/1 [00:00< 6 6 6 box_loss 2.375 0:00, 2.16s	1.301 s/it] Instances s00:00, 4.5 100 1 8 91 cls_loss 1.316 s/it] Instances	0.9586 Box(P 53it/s] 0.8 1 0.725 0.675 dfl_loss 1.031 Box(P	59 R 0.389 0 0.75 0.418 Instances 62
Size 34/10 640: 100 mAP50 r 0.528 0.497 0.653 unr 0.435 Eg Size 35/10 640: 100	0000 0% 4/4 [000 0.243 micro 0.149 poi 0.465 melted pai 0.115 0000 0% 4/4 [000 0.221	7.83G Class: 100% all ocrack rosity rticle PU_mem 7.83G 0:08<00 Class:	2.202 2:00, 1.81s Images 1/1 [00:00< 6 6 6 6 box_loss 2.375 2:00, 2:16s Images 1/1 [00:00<	1.301 [instances	0.9586 Box(P 53it/s] 0.8 1 0.725 0.675 dfl_loss 1.031 Box(P 59it/s]	59 R 0.389 0 0.75 0.418 Instances 62 R

0 501	porosity 0.344	6	8	0.522	0.75
	0.344 elted particle	6	91	0.934	0.309
	0.185				
Ер	och GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size	000 7.83G	2 020	1 0/17	0.042	63
	% 4/4 [00:08<0	0:00, 2.05	s/it]		
mΛD50 m	Class AP50-95): 100%	Images			R
	all			0.791	0.394
0.424	0.201 microcrack	6	1	1	0
0	0				
0 664	porosity 0.415	6	8	0.505	0.75
unm	elted particle	6	91	0.867	0.432
0.609	0.187				
	och GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 37/10	000 7.83G	1.912	1.147	0.9333	62
	% 4/4 [00:07<0	0:00, 1.829	s/it]		
mAP50 m	Class AP50-95): 100%			Box(P 31it/s]	R
	all			0.766	0.269
0.369	0.145 microcrack	6	1	1	0
0.199	0.0236	6	8	0 005	0.5
0.655	porosity 0.351	O	0	0.885	0.5
	elted particle 0.0606	6	91	0.412	0.308
Ep Size	och GPU_mem	box_loss	cls_loss	dfl_loss	Instances
38/10	000 7.83G			0.9782	97
640: 100	% 4/4 [00:08<0 Class	0:00, 2.229 Images		Box (P	R
mAP50 m	AP50-95): 100%	1/1 [00:00<	<00:00, 4.0	62it/s]	
0.415	all 0.203	6	100	0.772	0.386
0 0172	microcrack	6	1	1	0
0.0172	0.00172 porosity	6	8	0.447	0.75
	0.407 elted particle	6	91	0.87	0.407
0.596		Ü	91	0.07	0.407

	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 39/	10000	7.83G	1.952	1.302	0.9078	101
640: 1	.00% 4/4	[00:08<00	:00, 2.069	s/it]		
mAP50	mAP50-9	95): 100%	1/1 [00:00<	:00:00, 2.8	Box(P B3it/s]	
	0.3	all	6	100	0.69	0.306
	m:	icrocrack	6	1	1	0
0	0	porosity	6	8	0.627	0.631
	0.3	383				
	inmelted 0.088	particle 31	6	91	0.442	0.286
Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
40/	10000	7.83G	2.265	1.448	0.9639	70
640: 1	.00% 4/4	[00:07<00	:00, 1.839	s/it] Instances	Box(P	R
mAP50	mAP50-9	95): 100%	1/1 [00:00<	<00:00, 4.1	l6it/s]	
0.346	0.1		6	100	0.784	0.304
	m:	icrocrack	6	1	1	0
0		porosity	6	8	0.484	0.625
	0.3	316				
	inmetted 0.1	particle 161	6	91	0.867	0.287
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 41/	10000	7 83G	2 238	1 437	0.9741	56
640: 1	.00% 4/4	[00:08<00	:00, 2.209	/itl		
mAP50	mAP50-9	Class 95): 100%	Images 1/1 [00:00<	Instances 00:00, 4.5	Box(P 57it/sl	R
		all	6	100	0.833	0.337
0.393		178 icrocrack	6	1	1	0
0	0	norocity	6	8	0.774	0.625
0.712	0.4	porosity 408	O	0	0.774	0.025
0.468		particle 127	6	91	0.726	0.385
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
-	10000	7.83G	2.036		0.957	58
640: 1	.00% 4/4	[00:08<00 Class	:00, 2.05s	/it] Instances	Box(P	R
		Ctass	Tillages	THE COLICES	טעע (וי	11

mAP50			1/1 [00:00<			
0.515	0.242	all 2	6	100	0.37	0.544
o 497	micı 0.149	rocrack	6	1	0.21	0.421
		orosity	6	8	0.421	0.75
u	nmelted pa	article	6	91	0.478	0.462
	0.12					
Size	Epoch (GPU_mem	box_loss	cls_loss	dfl_loss	Instances
			2.455 0:00, 1.82s		0.982	102
		Class	Images	Instances	Box(P	R
		all	1/1 [00:00< 6		0.75	0.385
0.441	0.216 mici	6 rocrack	6	1	1	0
0.249	0.0995	5 orosity	6	8	0.591	0.75
	0.382	2				0.405
	0.167		U	91	0.00	0.403
	Epoch (GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 44/	10000	7.83G	2.242	1.094	dfl_loss 0.9446	
Size 44/	10000	7.83G 00:08<00	2.242 0:00, 2.14s	1.094 /it]	0.9446	66
Size 44/ 640: 1	10000 00% 4/4 [6 mAP50-95]	7.83G 90:08<00 Class): 100%	2.242 2:00, 2.14s Images 1/1 [00:00<	1.094 /it] Instances 00:00, 4.4	0.9446 Box(P	66 R
Size 44/ 640: 1 mAP50	10000 00% 4/4 [6 mAP50-95]	7.83G 00:08<00 Class): 100% all	2.242 0:00, 2.14s Images 1/1 [00:00< 6	1.094 /it] Instances 00:00, 4.4 100	0.9446 Box(P 47it/s] 0.705	66 R 0.292
Size 44/ 640: 1 mAP50 0.323	10000 00% 4/4 [0 mAP50-95] 0.133 micu 0.0199	7.83G 00:08<00 Class): 100% all 3 rocrack 9	2.242 2:00, 2.14s Images 1/1 [00:00< 6	1.094 /it] Instances 00:00, 4.4 100	0.9446 Box(P 47it/s] 0.705	66 R 0.292 0
Size 44/ 640: 1 mAP50 0.323	10000 00% 4/4 [0 mAP50-95] 0.133 micr 0.0199	7.83G 90:08<00 Class): 100% all 3 rocrack 9	2.242 0:00, 2.14s Images 1/1 [00:00< 6	1.094 /it] Instances 00:00, 4.4 100	0.9446 Box(P 47it/s] 0.705	66 R 0.292 0
Size 44/ 640: 1 mAP50 0.323 0.199 0.498	10000 00% 4/4 [6 mAP50-95] 0.133 micr 0.0199 pc 0.305 nmelted pa	7.83G 00:08<00 Class): 100% all 3 rocrack 9 orosity 5 article	2.242 2:00, 2.14s Images 1/1 [00:00< 6	1.094 /it] Instances 00:00, 4.4 100	0.9446 Box(P 47it/s] 0.705	66 R 0.292 0 0.625
Size 44/ 640: 1 mAP50 0.323 0.199 0.498 u	10000 00% 4/4 [0 mAP50-95] 0.133 micr 0.0199 po 0.305 nmelted pa 0.0748	7.83G 00:08<00 Class): 100% all 3 rocrack 9 orosity 5 article	2.242 2:00, 2.14s Images 1/1 [00:00< 6 6	1.094 /it] Instances 00:00, 4.4 100 1 8	0.9446 Box(P 47it/s] 0.705 1 0.554 0.561	66 R 0.292 0 0.625
Size 44/ 640: 1 mAP50 0.323 0.199 0.498 u.271	10000 00% 4/4 [6 mAP50-95] 0.133 micr 0.0199 0.305 nmelted pa 0.0748	7.83G 90:08<00 Class): 100% all 3 rocrack 9 orosity 5 article 8 GPU_mem	2.242 2:00, 2.14s Images 1/1 [00:00< 6 6 6	1.094 /it] Instances 00:00, 4.4 100 1 8 91 cls_loss	0.9446 Box(P 47it/s] 0.705 1 0.554 0.561 dfl_loss	66 R 0.292 0 0.625 0.252 Instances
Size 44/ 640: 1 mAP50 0.323 0.199 0.498 u 0.271	10000 00% 4/4 [6 mAP50-95] 0.133 micr 0.0199 0.305 nmelted pa 0.0748 Epoch	7.83G 90:08<00 Class): 100% all 3 rocrack 9 orosity 5 article 8 GPU_mem 7.83G 90:07<00	2.242 2:00, 2.14s Images 1/1 [00:00< 6 6 6 6 box_loss 2.216 2:00, 1.93s	1.094 /it] Instances 00:00, 4.4 100 1 8 91 cls_loss 1.101 /it]	0.9446 Box(P 47it/s] 0.705 1 0.554 0.561 dfl_loss 0.9403	66 R 0.292 0 0.625 0.252 Instances
Size 44/ 640: 1 mAP50 0.323 0.199 0.498 u 0.271	10000 00% 4/4 [6 mAP50-95] 0.133 micr 0.0199 pr 0.305 nmelted pr 0.0748 Epoch (6) 10000 00% 4/4 [6]	7.83G 00:08<00 Class): 100% all 3 rocrack 9 orosity 5 article 8 GPU_mem 7.83G 00:07<00 Class	2.242 2:00, 2.14s Images 1/1 [00:00< 6 6 6 6 6 box_loss 2.216	1.094 /it] Instances 00:00, 4.4 100 1 8 91 cls_loss 1.101 /it] Instances	0.9446 Box(P 47it/s] 0.705 1 0.554 0.561 dfl_loss 0.9403 Box(P	66 R 0.292 0 0.625 0.252 Instances
Size 44/ 640: 1 mAP50 0.323 0.199 0.498 0.271 Size 45/ 640: 1 mAP50	10000 00% 4/4 [6 mAP50-95] 0.133 micr 0.0199 0.305 nmelted pa 0.0748 Epoch (10000 00% 4/4 [6] mAP50-95]	7.83G 00:08<00 Class): 100% all 3 rocrack 9 orosity 5 article 8 GPU_mem 7.83G 00:07<00 Class): 100% all	2.242 2:00, 2.14s Images 1/1 [00:00< 6 6 6 6 6 box_loss 2.216 2:00, 1.93s Images	1.094 /it] Instances 00:00, 4.4 100 1 8 91 cls_loss 1.101 /it] Instances	0.9446 Box(P 47it/s] 0.705 1 0.554 0.561 dfl_loss 0.9403 Box(P	66 R 0.292 0 0.625 0.252 Instances
Size 44/ 640: 1 mAP50 0.323 0.199 0.498 u 0.271 Size 45/ 640: 1	10000 00% 4/4 [0 mAP50-95] 0.133 micr 0.0199 0.305 nmelted pa 0.0748 Epoch (0 10000 00% 4/4 [0 mAP50-95]	7.83G 00:08<00 Class): 100% all 3 rocrack 9 orosity 5 article 8 GPU_mem 7.83G 00:07<00 Class): 100% all 6 rocrack	2.242 2:00, 2.14s Images 1/1 [00:00< 6 6 6 6 box_loss 2.216 2:00, 1.93s Images 1/1 [00:00<	1.094 /it] Instances 00:00, 4.4 100 1 8 91 cls_loss 1.101 /it] Instances 00:00, 3.1	0.9446 Box(P 47it/s] 0.705 1 0.554 0.561 dfl_loss 0.9403 Box(P	66 R 0.292 0 0.625 0.252 Instances 98 R

0.500	porosity	6	8	0.307	0.75
0.538 (mmelte	0.348 ed particle	6	91	0.38	0.516
0.48		J	31	0.30	0.510
Fnoch	GPII mem	hov loss	cle loss	dfl loss	Instances
Size	_	_	_	_	
				0.9741	92
640: 100% 4/	elass: المرادة (المرادة) Class	Images	Instances	Box(P	R
mAP50 mAP50	9-95): 100%	1/1 [00:00<	<00:00, 4.4	45it/s]	
0.383		6	100	0.704	0.404
	microcrack	6	1	1	Θ
0.0108 0		•	•	0.651	0.700
0.611	porosity 0.331	6	8	0.651	0.702
unmelte	ed particle	6	91	0.463	0.511
0.527	0.173				
Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size	7 026	2 000	1 127	0.0363	60
640: 100% 4/				0.9363	68
	Class	Images	Instances	Box(P	R
mAP50 mAP50	9-95): 100%	1/1 [00:00< 6	.00:00, 4.6 100	68it/s] 0.567	0.75
0.732	0.243	O .	100	0.507	0.75
	microcrack	6	1	0.947	1
0.995	porosity	6	8	0.363	0.625
0.615	335				
unmelte 0.584 0		6	91	0.392	0.626
Epoch Size	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
	7.83G	2.201	1.277	0.907	140
640: 100% 4/	_	•	_	D (D	
mAP50 mAP50	Class (100% : 100%	1mages 1/1 [00:00<	Instances 3.2:00:00		R
	all	6	100	0.588	0.676
0.669	0.234	6	1	0.912	1
0.995	microcrack 0.298	U	1	0.912	1
0.410	porosity	6	8	0.294	0.5
	0.209 ed particle	6	91	0.559	0.527
	0.194	· ·	- 51	0.555	0.32,

	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size	10000	7 83G	1 870	1 153	0.92	79
640: 1	.00% 4/4	[00:07<00	:00, 1.989	s/it]		
mAP50	mAP50-9	Class 95): 100%	Images 1/1 [00:00<	Instances <00:00, 4.6	Box(P S0it/sl	R
		all			0.773	0.35
	0.2 mi	icrocrack	6	1	1	0
0.995	0.1	199 porosity	6	8	0.486	0.5
	0.3	309				
0.635	inmelted 0.2	particle 219	6	91	0.833	0.549
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 50/	10000	7.83G	2.138	1.189	0.9367	105
640: 1	.00% 4/4	[00:08<00	:00, 2.22s	s/it] Instances	Box(P	R
mAP50	mAP50-9	95): 100%	1/1 [00:00<	<00:00, 4.6	66it/s]	
0.248	0.08		6	100	0.633	0.289
0		icrocrack	6	1	1	0
		porosity	6	8	0.355	0.5
	0.1 Inmelted	133 particle	6	91	0.544	0.368
	0.		Ū	31	0.511	01300
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 51/	10000	7.83G	2.062	1.207	0.9402	99
640: 1	.00% 4/4	[00:07<00	:00, 1.779	s/itl	Box(P	D
mAP50	mAP50-9	95): 100%	1/1 [00:00<	<00:00, 4.4	H4it/s]	
0.674	0.2	all 238	6	100	0.731	0.374
	mi	icrocrack	6	1	1	0
0.995	0.2	256 porosity	6	8	0.413	0.617
0.47	0.27	78				
0.556	inmetted 0.1	particle 179	6	91	0.779	0.504
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 52/	10000	7.83G	2.09	0.9636	0.9315	70
		[00:08<00	:00, 2.109	s/it]		
		Class	Images	Instances	Box(P	R

mAP50 mAP	250-95): 100% all			63it/s] 0.377	0.304
	0.113				
0	microcrack 0		1	0	0
0.446	porosity 0.212	6	8	0.434	0.625
	ted particle	6	91	0.697	0.286
Epoc Size	ch GPU_mem	box_loss	cls_loss	dfl_loss	Instances
	00 7.830 4/4 [00:08<0	0:00, 2.179	s/it]		
mAP50 mAF	950-95): 100%	Images 1/1 [00:00<	<00:00, 4.4	46it/s]	
0.302	all 0.141	6	100	0.678	0.342
	microcrack 0	6	1	1	0
0.494	porosity	6	8	0.421	0.75
	ted particle	6	91	0.613	0.275
Enoc	h GDII mom	hov loce	cle loce	dfl locc	Inctances
Size	ch GPU_mem	_	_	_	
Size 54/1000	7.830	1.971	1.143	_	
Size 54/1000 640: 100%	7.830 4/4 [00:07<0 Class 250-95): 100%	1.971 0:00, 1.819 Images 1/1 [00:00	1.143 5/it] Instances <00:00, 4.	0.9977 Box(P 55it/s]	35 R
Size 54/1000 640: 100% mAP50 mAF	7.830 4/4 [00:07<0 Class 250-95): 100% all	1.971 0:00, 1.819 Images 1/1 [00:00	1.143 s/it] Instances	0.9977 Box(P 55it/s]	35 R
Size 54/1000 640: 100% mAP50 mAF 0.293	00 7.830 4/4 [00:07<0 Class 250-95): 100% all 0.156 microcrack	1.971 0:00, 1.81s Images 1/1 [00:00<	1.143 5/it] Instances <00:00, 4.	0.9977 Box(P 55it/s]	35 R
Size 54/1006 640: 100% mAP50 mAF 0.293	00 7.830 4/4 [00:07<0 Class P50-95): 100% all 0.156 microcrack 0	1.971 0:00, 1.81s Images 1/1 [00:00< 6	1.143 s/it] Instances <00:00, 4.5	0.9977 Box(P 55it/s] 0.837	35 R 0.25
Size 54/1000 640: 100% mAP50 mAF 0.293 0	00 7.830 4/4 [00:07<0 Class P50-95): 100% all 0.156 microcrack 0	1.971 0:00, 1.81s Images 1/1 [00:00< 6	1.143 s/it] Instances <00:00, 4.5 100	0.9977 Box(P 55it/s] 0.837 1 0.713	35 R 0.25 0 0.621
Size 54/1000 640: 100% mAP50 mAF 0.293 0	00 7.830 4/4 [00:07<0 Class P50-95): 100% all 0.156 microcrack 0 porosity 0.329	1.971 0:00, 1.81s Images 1/1 [00:00< 6	1.143 s/it] Instances <00:00, 4.! 100	0.9977 Box(P 55it/s] 0.837 1 0.713	35 R 0.25 0 0.621
Size 54/1000 640: 100% mAP50 mAF 0.293 0 0.549 unmel 0.331	00 7.830 4/4 [00:07<0 Class 250-95): 100% all 0.156 microcrack 0 porosity 0.329	1.971 0:00, 1.819 Images 1/1 [00:00-6 6	1.143 5/it] Instances <00:00, 4.! 100 1	0.9977 Box(P 55it/s] 0.837 1 0.713	35 R 0.25 0 0.621 0.13
Size 54/1000 640: 100% mAP50 mAF 0.293 0 0.549 unmel 0.331 Epoc Size 55/1000	00 7.830 4/4 [00:07<0 Class 250-95): 100% all 0.156 microcrack 0 porosity 0.329 ted particle 0.139	1.971 0:00, 1.81s Images 1/1 [00:00<6 6 6 6 6 box_loss	1.143 s/it] Instances <00:00, 4.9 100 1 8 91 cls_loss 1.091	0.9977 Box(P 55it/s] 0.837 1 0.713 0.797 dfl_loss	35 R 0.25 0 0.621 0.13
Size 54/1006 640: 100% mAP50 mAF 0.293 0 0.549 unmel 0.331 Epoc Size 55/1006 640: 100%	00 7.830 4/4 [00:07<0 Class 250-95): 100% all 0.156 microcrack 0 porosity 0.329 ted particle 0.139 ch GPU_mem 0 7.830 4/4 [00:09<0 Class	1.971 0:00, 1.81s Images 1/1 [00:00<6 6 6 6 6 box_loss 2.148 0:00, 2.26s Images	1.143 s/it] Instances <00:00, 4.5 100 1 8 91 cls_loss 1.091 s/it] Instances	0.9977 Box(P 55it/s] 0.837 1 0.713 0.797 dfl_loss 0.937 Box(P	35 R 0.25 0 0.621 0.13
Size 54/1006 640: 100% mAP50 mAF 0.293 0 0.549 unmel 0.331 Epoc Size 55/1006 640: 100% mAP50 mAF	7.836 4/4 [00:07<0 Class 250-95): 100% all 0.156 microcrack 0 porosity 0.329 ted particle 0.139 ch GPU_mem 0 7.836 4/4 [00:09<0 Class 250-95): 100% all	1.971 0:00, 1.81s Images 1/1 [00:00< 6 6 6 6 box_loss 2.148 0:00, 2.26s Images 1/1 [00:00<	1.143 s/it] Instances <00:00, 4.5 100 1 8 91 cls_loss 1.091 s/it] Instances	0.9977 Box(P 55it/s] 0.837 1 0.713 0.797 dfl_loss 0.937 Box(P	35 R 0.25 0 0.621 0.13 Instances
Size 54/1006 640: 100% mAP50 mAF 0.293 0 0.549 unmel 0.331 Epoc Size 55/1006 640: 100%	00 7.830 4/4 [00:07<0 Class 250-95): 100% all 0.156 microcrack 0 porosity 0.329 ted particle 0.139 th GPU_mem 00 7.830 4/4 [00:09<0 Class 250-95): 100%	1.971 0:00, 1.81s Images 1/1 [00:00< 6 6 6 box_loss 2.148 0:00, 2.26s Images 1/1 [00:00< 6	1.143 5/it] Instances <00:00, 4.! 100 1 cls_loss 1.091 5/it] Instances <00:00, 4.!	0.9977 Box(P 55it/s] 0.837 1 0.713 0.797 dfl_loss 0.937 Box(P 53it/s]	35 R 0.25 0 0.621 0.13 Instances 144 R

0 506	0	porosity		6	8	0.614	0.598
		particle		6	01	0.522	0 100
	0.0			U	91	0.322	0.190
	Epoch	GPU mem	box los	ss cls	sloss	dfl loss	Instances
Size	•	_	_		_	_	
56/ 640: 1	10000 00% 4/4	7.83G [00:08<06	1.9 0:00. 2.3	99 18s/itl	1.002	0.9339	100
		Class	Image	es Inst	tances	Box (P	R
		95): 100% all	1/1 [00:0			0.675	0.377
0.415	0.2	226					
0.249	m: 0.3	icrocrack 199		6	1	1	0
		porosity		6	8	0.38	0.75
0.563		particle		6	91	0.646	0.38
	0.1			U	91	0.040	0.50
	Enach	CDII mom	hov lo	.c. cl.	1000	dfl_loss	Thetancos
Size	Гросп	dru_illelii	DUX_tus	55 (1)	5_1055	u11_t055	Tilstalices
_	10000	7.83G	2.12	24 (9.9906	0.946	52
640: 1	00% 4/4	[00:07<00					
A DE O	ADEO (Image				R
		95): 100% all	1/1 [00:0	90<00:00 6	9, 4.48 100	0.868	0.299
0.71	0.29				_	_	
0.995	m: 0.2	icrocrack		6	1	1	Θ
0.995		porosity		6	8	0.742	0.5
0.582	0.3			J	Ū	017.12	0.5
		particle		6	91	0.863	0.396
0.552	0.2	221					
	Epoch	GPU_mem	box_los	s cl	s_loss	dfl_loss	Instances
Size		_	_		_	_	
		7.83G			9.9515	0.9572	76
640: 1	00% 4/4	(1255	•		tances	Box (P	R
mAP50	mAP50-9	95): 100%				•	IX
		all	_, _ [00]	_	100	0.467	0.636
0.602		209		6	1	0.719	1
0.995		icrocrack 199		6	1	0.719	1
0.555	01.	porosity		6	8	0.428	0.625
0.577		. 35		C	0.1	0.254	0.201
0.233		particle 774		6	91	0.254	0.284

	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 59/	10000	7.83G	2.136	1.087	0.9628	60
		[00:08<00	:00, 2.149	s/it]		
mΔP50	mΔP50-0			Instances 4.4 ,00:00	Box(P	R
		all	6		0.517	0.725
0.705	0.3		6	1	0.584	1
0.995	0.4	197				
0 530	0.3	porosity	6	8	0.428	0.625
ι	unmelted	particle	6	91	0.538	0.549
0.579	0.2	244				
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 60/	10000	7.83G	1.996	0.9151	0.9365	69
		[00:07<00	:00, 1.859	s/it]		
mAP50	mAP50-9	05): 100%	1/1 [00:00<	instances 00:00, 4.5	Box(P 56it/s]	R
		all	6	100	0.649	0.255
0.384	0.1 mi		6	1	1	Θ
0.332	0.1	133		0	0 54	0.5
0.507	0.2	porosity 258	6	8	0.54	0.5
		particle	6	91	0.407	0.264
0.312	0.09	964				
Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
	10000	7.83G	2.044	0.9931	0.918	81
640: 1	L00% 4/4	[00:08<00	:00, 2.199	s/it]	Box(P	D
mAP50	mAP50-9			<00:00, 4.4		ĸ
0 7E1	0.3	all	6	100	0.454	0.912
0.751		icrocrack	6	1	1	1
0.995	0.4		C	0	0 0670	1
0.605	0.4	porosity 107	6	8	0.0678	1
		particle	6	91	0.294	0.736
0.655	0.2	273				
Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
62/	10000	7.83G	2.027	0.9998	0.8943	128
640: 1	100% 4/4	[00:08<00 Class	:00, 2.19s Images		Box(P	R
		0 1000		22 10005	20//(1	. ,

mAP50	mΔP50-05)	. 100%	1/1 [00:00<	00.00 4.3	20i+/cl	
		all			0.609	0.315
0.469	0.143	ocrack	6	1	1	0
0.497	0.0498		0			0
0 530	po 0.254	rosity	6	8	0.403	0.625
u	nmelted pa	rticle	6	91	0.425	0.319
0.371	0.125					
	Epoch G	PU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 63/	10000	7 83G	2.104	1 128	A 9184	116
		0:07<00	0:00, 1.82s	/it]		
mAP50	mAP50-95)		Images 1/1 [00:00<			R
		all	6	100	0.827	0.374
0.781	0.342	ocrack	6	1	1	0
0.995	0.321					-
0.68	po 0.45	rosity	6	8	0.799	0.497
u	nmelted pa		6	91	0.683	0.626
0.667	0.254					
	Epoch G	PU_mem	box_loss	cls_loss	dfl_loss	Instances
Size		_	_	_	_	
Size 64/	10000	7.83G 0:08<00	2.1 0:00, 2.18s	0.98 /it]	0.9371	136
Size 64/ 640: 1	10000 00% 4/4 [0	7.83G 0:08<00 Class	2.1 0:00, 2.18s Images	0.98 /it] Instances	0.9371 Box(P	136
Size 64/ 640: 1 mAP50	10000 00% 4/4 [0 mAP50-95)	7.83G 0:08<00 Class : 100% all	2.1 0:00, 2.18s	0.98 /it] Instances 00:00, 4.3	0.9371 Box(P 32it/s]	136 R
Size 64/ 640: 1 mAP50	10000 00% 4/4 [0 mAP50-95) 0.193	7.83G 0:08<00 Class : 100% all	2.1 0:00, 2.18s Images 1/1 [00:00< 6	0.98 /it] Instances 00:00, 4.3	0.9371 Box(P 32it/s]	136 R
Size 64/ 640: 1 mAP50 0.508	10000 00% 4/4 [0 mAP50-95) 0.193 micr 0.0663	7.83G 0:08<00 Class : 100% all	2.1 0:00, 2.18s Images 1/1 [00:00< 6	0.98 /it] Instances 00:00, 4.3 100	0.9371 Box(P 32it/s] 0.764	136 R 0.396
Size 64/ 640: 1 mAP50 0.508 0.332	10000 00% 4/4 [0 mAP50-95) 0.193 micr 0.0663	7.83G 0:08<00 Class : 100% all ocrack	2.1 0:00, 2.18s Images 1/1 [00:00< 6	0.98 /it] Instances 00:00, 4.3 100	0.9371 Box(P 32it/s] 0.764	136 R 0.396
Size 64/ 640: 1 mAP50 0.508 0.332 0.625 u	10000 00% 4/4 [0 mAP50-95) 0.193 micr 0.0663 po 0.325 nmelted pa	7.83G 0:08<0G Class : 100% all ocrack rosity	2.1 0:00, 2.18s Images 1/1 [00:00< 6	0.98 /it] Instances 00:00, 4.3 100	0.9371 Box(P 32it/s] 0.764 1 0.666	136 R 0.396 0
Size 64/ 640: 1 mAP50 0.508 0.332 0.625	10000 00% 4/4 [0 mAP50-95) 0.193 micr 0.0663 po 0.325 nmelted pa	7.83G 0:08<0G Class : 100% all ocrack rosity	2.1 0:00, 2.18s Images 1/1 [00:00< 6 6	0.98 /it] Instances 00:00, 4.3 100 1 8	0.9371 Box(P 32it/s] 0.764 1 0.666 0.626	136 R 0.396 0 0.749
Size 64/ 640: 1 mAP50 0.508 0.332 0.625 u	10000 00% 4/4 [0 mAP50-95) 0.193 micr 0.0663 po 0.325 nmelted pa	7.83G 0:08<00 Class : 100% all ocrack rosity rticle	2.1 0:00, 2.18s Images 1/1 [00:00< 6 6 6	0.98 /it] Instances 00:00, 4.3 100 1 8	0.9371 Box(P 32it/s] 0.764 1 0.666	136 R 0.396 0 0.749
Size 64/ 640: 1 mAP50 0.508 0.332 0.625 u 0.568	10000 00% 4/4 [0 mAP50-95) 0.193 micr 0.0663 po 0.325 nmelted pa 0.188 Epoch G	7.83G 0:08<00 Class : 100% all ocrack rosity rticle PU_mem 7.83G	2.1 0:00, 2.18s Images 1/1 [00:00< 6 6 6 6 6 6 box_loss 2.051	0.98 /it] Instances 00:00, 4.3 100 1 8 91 cls_loss 1.015	0.9371 Box(P B2it/s] 0.764 1 0.666 0.626 dfl_loss	136 R 0.396 0 0.749
Size 64/ 640: 1 mAP50 0.508 0.332 0.625 u 0.568	10000 00% 4/4 [0 mAP50-95) 0.193 micr 0.0663 po 0.325 nmelted pa 0.188 Epoch G	7.83G 0:08<00 Class : 100% all ocrack rosity rticle PU_mem 7.83G 0:08<00	2.1 0:00, 2.18s Images 1/1 [00:00< 6 6 6 6 6 box_loss 2.051 0:00, 2.24s	0.98 /it] Instances 00:00, 4.3 100 1 8 91 cls_loss 1.015 /it]	0.9371 Box(P 32it/s] 0.764 1 0.666 0.626 dfl_loss 0.9215	136 R 0.396 0 0.749 0.44 Instances
Size 64/ 640: 1 mAP50 0.508 0.332 0.625 u 0.568	10000 00% 4/4 [0 mAP50-95) 0.193 micr 0.0663 po 0.325 nmelted pa 0.188 Epoch G	7.83G 0:08<00 Class : 100% all ocrack rosity rticle PU_mem 7.83G 0:08<00	2.1 0:00, 2.18s Images 1/1 [00:00< 6 6 6 6 box_loss 2.051 0:00, 2.24s	0.98 /it] Instances 00:00, 4.3 100 1 8 91 cls_loss 1.015 /it] Instances 00:00, 4.3	0.9371 Box(P 32it/s] 0.764 1 0.666 0.626 dfl_loss 0.9215 Box(P	136 R 0.396 0 0.749 0.44 Instances 73 R
Size 64/ 640: 1 mAP50 0.508 0.332 0.625 0.568 Size 65/ 640: 1 mAP50	10000 00% 4/4 [0 mAP50-95) 0.193 micr 0.0663 po 0.325 nmelted pa 0.188 Epoch G 10000 00% 4/4 [0 mAP50-95)	7.83G 0:08<00% Class : 100% all ocrack rosity rticle PU_mem 7.83G 0:08<00% Class : 100% all	2.1 0:00, 2.18s Images 1/1 [00:00< 6 6 6 6 box_loss 2.051 0:00, 2.24s Images	0.98 /it] Instances 00:00, 4.3 100 1 8 91 cls_loss 1.015 /it] Instances	0.9371 Box(P 32it/s] 0.764 1 0.666 0.626 dfl_loss 0.9215 Box(P	136 R 0.396 0 0.749 0.44 Instances
Size 64/ 640: 1 mAP50 0.508 0.332 0.625 u 0.568 Size 65/ 640: 1	10000 00% 4/4 [0 mAP50-95) 0.193 micr 0.0663 po 0.325 nmelted pa 0.188 Epoch G 10000 00% 4/4 [0 mAP50-95) 0.238	7.83G 0:08<00% Class : 100% all ocrack rosity rticle PU_mem 7.83G 0:08<00% Class : 100% all	2.1 0:00, 2.18s Images 1/1 [00:00< 6 6 6 6 box_loss 2.051 0:00, 2.24s Images 1/1 [00:00<	0.98 /it] Instances 00:00, 4.3 100 1 8 91 cls_loss 1.015 /it] Instances 00:00, 4.3	0.9371 Box(P Box(P 0.764 1 0.666 0.626 dfl_loss 0.9215 Box(P Box(P	136 R 0.396 0 0.749 0.44 Instances 73 R

0 717	porosity	6	8	0.838	0.75
	0.479 Inmelted particle	6	91	0.686	0 577
	0.206		31	01000	01377
	Epoch GPU mem	box loss	cls loss	dfl loss	Instances
Size	_	_	_	_	
	10000 7.83G .00% 4/4 [00:07<0			0.9804	64
	Class	Images	Instances		R
mAP50	mAP50-95): 100% all			47it/s] 0.83	0.412
0.605	0.219				
0 497	microcrack 0.0995	6	1	1	0
	porosity	6	8	0.847	0.699
	0.357 inmelted particle	6	01	0.643	A 538
	0.201	U	91	0.043	0.550
	Epoch GPU_mem	hov loss	cle loce	dfl locc	Instances
Size	Lpoch dro_mem	DOX_033	Cts_t0ss	u1 t_t033	Tilstalices
-	7.83G			0.904	86
040: 1	00:08<0 4/4 00:08 Class	Images		Box(P	R
mAP50	mAP50-95): 100%	1/1 [00:00<	<00:00, 4.4	45it/s]	0. 202
0.367	0.181	6	100	0.789	0.393
	microcrack	6	1	1	Θ
0	0 porosity	6	8	0.845	0.75
	0.405				
	inmelted particle 0.139	6	91	0.523	0.429
0.41					
Size	Epoch GPU_mem	box_loss	cls_loss	dfl_loss	Instances
	7.83G	1.97	0.9313	0.9392	63
640: 1	.00:08<4/4 [00:08<0			Pay / D	D
mAP50	mAP50-95): 100%	Images 1/1 [00:00<			R
0 505	all		100	0.831	0.37
0.525	0.224 microcrack	6	1	1	0
0.332	0.0995				
0.68	porosity 0.378	6	8	0.825	0.593
u	inmelted particle	6	91	0.667	0.516
0.562	0.195				

	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 69/	10000	7.83G	1.898	0.873	0.9063	125
		[00:07<00	:00, 1.919	s/it]		
mAP50	mAP50-9	Class 95): 100%	1/1 [00:00<	instances 00:00, 4.5	Box(P 58it/sl	R
		all	6	100	0.766	0.306
0.441	0.1 mi	194 icrocrack	6	1	1	Θ
0.332	0.06	563				
0.627	0.4	porosity 107	6	8	0.823	0.587
u		particle	6	91	0.473	0.33
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size	10000	7 83G	1 005	A 0220	0.9125	84
		[00:08<00	:00, 2.249	s/it]		
mAD50	m / D5 0 _ (Class	Images	Instances 4.4 00:00,	Box(P	R
		all	6	100	0.772	0.389
0.488	0.2		6	1	1	0
0.332	0.06	563				
0 673	0.4	porosity	6	8	0.703	0.75
u	ınmelted	particle	6	91	0.612	0.418
0.458	0.1	193				
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 71/	10000	7.83G	1.9	0.892	0.9269	106
640: 1	.00% 4/4	[00:08<00	:00, 2.079	s/it]	D / D	D
mAP50	mAP50-9	Class 95): 100%		instances 00:00, 2.9	Box(P 99it/s]	К
0 400		all	6	100	0.707	0.255
0.409	0.1 mi	icrocrack	6	1	1	0
0.332	0.03		6	8	0.654	0.5
0.574	0.3	porosity 357	6	0	0.654	0.5
0.321		particle 992	6	91	0.467	0.264
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
	10000	7.83G	1.895		0.898	97
640: 1	.00% 4/4	[00:07<00 Class	:00, 1.93s Images		Box(P	R
		5 2 4 3 3	agc3	2.15 (4.1665	DOX	

mAP50	mAP50-95)	: 100% all	1/1 [00:00<		33it/s] 0.769	0.305
0.466	0.21					
0 332	micro 0.0663	ocrack	6	1	1	0
	poi		6	8	0.604	0.5
	0.371 nmelted par		6	01	0.702	0 414
	0.192		Ū	31	0.702	0.414
Size		_	_	_	dfl_loss	
		0:08<00	:00, 2.19s	/it]	0.9141	
mAP50	mAP50-95)	: 100%	1/1 [00:00<	00:00, 4.6		
0 467	0.197	all	6	100	0.899	0.269
		ocrack	6	1	1	0
	poi		6	8	1	0.489
	0.343 nmelted par		6	01	0.697	0.319
	0.148		Ü	31	0.037	0.313
Size					dfl_loss	
Size 74/	10000	7.83G 9:08<00	1.841 0:00, 2.11s	0.9313 /it]	0.9234	81
Size 74/ 640: 1	10000 00% 4/4 [00 mAP50-95)	7.83G 0:08<00 Class : 100%	1.841 0:00, 2.11s	0.9313 /it] Instances	0.9234 Box(P	81 R
Size 74/ 640: 1 mAP50	10000 00% 4/4 [00 mAP50-95)	7.83G 9:08<00 Class : 100% all	1.841 0:00, 2.11s Images 1/1 [00:00<	0.9313 /it] Instances 00:00, 2.9	0.9234 Box(P	81 R
Size 74/ 640: 1 mAP50 0.541	10000 00% 4/4 [00 mAP50-95); 0.216 micro	7.83G 9:08<00 Class : 100% all	1.841 0:00, 2.11s Images 1/1 [00:00< 6	0.9313 /it] Instances 00:00, 2.9	0.9234 Box(P 92it/s] 0.834	81 R
Size 74/ 640: 1 mAP50 0.541	10000 00% 4/4 [00 mAP50-95); 0.216 micro 0.0498	7.83G 9:08<00 Class : 100% all	1.841 0:00, 2.11s Images 1/1 [00:00< 6	0.9313 /it] Instances 00:00, 2.9 100	0.9234 Box(P 92it/s] 0.834	81 R 0.321
Size 74/ 640: 1 mAP50 0.541 0.497 0.567	10000 00% 4/4 [00 mAP50-95); 0.216 micro 0.0498 por 0.388	7.83G 9:08<00 Class : 100% all ocrack rosity	1.841 0:00, 2.11s Images 1/1 [00:00< 6 6	0.9313 /it] Instances 00:00, 2.9 100 1	0.9234 Box(P 92it/s] 0.834 1 0.771	81 R 0.321 0
Size 74/ 640: 1 mAP50 0.541 0.497 0.567	10000 00% 4/4 [00 mAP50-95); 0.216 micro 0.0498 por 0.388 nmelted par	7.83G 9:08<00 Class : 100% all ocrack rosity	1.841 0:00, 2.11s Images 1/1 [00:00< 6	0.9313 /it] Instances 00:00, 2.9 100	0.9234 Box(P 92it/s] 0.834	81 R 0.321 0
Size 74/ 640: 1 mAP50 0.541 0.497 0.567	10000 00% 4/4 [00 mAP50-95); 0.216 micro 0.0498 por 0.388 nmelted para 0.211	7.83G 9:08<00 Class : 100% all ocrack rosity rticle	1.841 0:00, 2.11s Images 1/1 [00:00< 6 6	0.9313 /it] Instances :00:00, 2.9 100 1 8	0.9234 Box(P 92it/s] 0.834 1 0.771 0.732	81 R 0.321 0
Size 74/640: 1 mAP50 0.541 0.497 0.567 u 0.558	10000 00% 4/4 [00 mAP50-95); 0.216 micro 0.0498 por 0.388 nmelted par 0.211 Epoch GF	7.83G 9:08<00 Class : 100% all ocrack rosity rticle PU_mem 7.83G	1.841 0:00, 2.11s Images 1/1 [00:00< 6 6 6 6 6 box_loss	0.9313 /it] Instances 00:00, 2.9 100 1 8 91 cls_loss 0.9023	0.9234 Box(P 92it/s] 0.834 1 0.771 0.732 dfl_loss	81 R 0.321 0 0.5 0.462
Size 74/640: 1 mAP50 0.541 0.497 0.567 u 0.558 Size 75/640: 1	10000 00% 4/4 [00 mAP50-95); 0.216 micro 0.0498 por 0.388 nmelted par 0.211 Epoch GF	7.83G 9:08<00 Class 100% all ocrack rosity rticle PU_mem 7.83G 9:07<06	1.841 0:00, 2.11s Images 1/1 [00:00< 6 6 6 6 box_loss 1.866 0:00, 1.88s Images	0.9313 /it] Instances 00:00, 2.9 100 1 8 91 cls_loss 0.9023 /it] Instances	0.9234 Box(P 92it/s] 0.834 1 0.771 0.732 dfl_loss 0.9076 Box(P	81 R 0.321 0 0.5 0.462 Instances
Size 74/640: 1 mAP50 0.541 0.497 0.567 u 0.558 Size 75/640: 1	10000 00% 4/4 [00 mAP50-95); 0.216 micro 0.0498 por 0.388 nmelted par 0.211 Epoch GF	7.83G 9:08<00 Class 100% all ocrack rosity rticle PU_mem 7.83G 9:07<06	1.841 0:00, 2.11s Images 1/1 [00:00< 6 6 6 6 box_loss 1.866 0:00, 1.88s	0.9313 /it] Instances 00:00, 2.9 100 1 8 91 cls_loss 0.9023 /it] Instances	0.9234 Box(P 92it/s] 0.834 1 0.771 0.732 dfl_loss 0.9076 Box(P	81 R 0.321 0 0.5 0.462 Instances
Size 74/640: 1 mAP50 0.541 0.497 0.567 u 0.558 Size 75/640: 1	10000 00% 4/4 [00 mAP50-95); 0.216 micro 0.0498 por 0.388 nmelted par 0.211 Epoch GF 10000 00% 4/4 [00 mAP50-95); 0.218	7.83G 9:08<00 Class 100% all ocrack rosity rticle PU_mem 7.83G 9:07<00 Class 100% all	1.841 0:00, 2.11s Images 1/1 [00:00< 6 6 6 box_loss 1.866 0:00, 1.88s Images 1/1 [00:00< 6	0.9313 /it] Instances 00:00, 2.9 100 1 8 91 cls_loss 0.9023 /it] Instances 00:00, 4.3	0.9234 Box(P 92it/s] 0.834 1 0.771 0.732 dfl_loss 0.9076 Box(P 84it/s] 0.804	81 R 0.321 0 0.5 0.462 Instances 109 R 0.406
Size 74/640: 1 mAP50 0.541 0.497 0.567 0.558 Size 75/640: 1 mAP50	10000 00% 4/4 [00 mAP50-95); 0.216 micro 0.0498 por 0.388 nmelted par 0.211 Epoch GF 10000 00% 4/4 [00 mAP50-95); 0.218	7.83G 9:08<00 Class 100% all ocrack rosity rticle PU_mem 7.83G 9:07<00 Class 100% all	1.841 0:00, 2.11s Images 1/1 [00:00< 6 6 6 6 box_loss 1.866 0:00, 1.88s Images 1/1 [00:00<	0.9313 /it] Instances 00:00, 2.9 100 1 8 91 cls_loss 0.9023 /it] Instances 00:00, 4.3	0.9234 Box(P 92it/s] 0.834 1 0.771 0.732 dfl_loss 0.9076 Box(P 84it/s]	81 R 0.321 0 0.5 0.462 Instances 109 R

0 715	por 0.458	osity	6	8	0.844	0.68
	458.0 Inmelted par	ticle	6	91	0.567	0.538
	0.197		-	_		
	Epoch GF	PU mem	box loss	cls loss	dfl loss	Instances
Size	•	_	_	_	_	
	′10000 .00% 4/4 [00				0.8752	62
		Class	Images	Instances	Box(P	R
mAP50				<00:00, 4. 100	56it/s] 0.818	0.41
0.626	0.278	all	0	100	0.010	0.41
0 407	micro	crack	6	1	1	0
0.497	0.0995 por	ositv	6	8	0.795	0.625
	0.46	J	_			
	nmelted par 0.273	ticle	6	91	0.658	0.604
Size	Epoch GF	PU_mem	box_loss	cls_loss	dfl_loss	Instances
_	10000	7.83G	1.921	0.9401	0.9114	63
640: 1	.00% 4/4 [00				Day/D	D
mAP50	mAP50-95):			<00:00, 2.	Box(P 76it/sl	R
		all	6	100	0.818	0.38
0.588	0.222	crack	6	1	1	0
0.497	0.0498					
0 642	por 0.393	osity	6	8	0.802	0.625
	nmelted par	ticle	6	91	0.653	0.516
0.624	0.224					
	Epoch GP	PU mem	box loss	cls loss	dfl loss	Instances
Size	10000	7 026	1 017	_ 0545	_	4.5
	.00% 4/4 [00			0.9545 s/itl	0.8969	46
	_	Class	Images	Instances	Box (P	R
mAP50	mAP50-95):	100% : all	1/1 [00:00 6	<00:00, 4. 100		0.437
0.66	0.297	acc	U	100	0.050	0.437
0.497		crack	6	1	1	0
0.497		osity	6	8	0.955	0.75
0.804	0.535	_		0.1	0.733	
0.679	nmelted par 0.257	Ticle	6	91	0.732	0.56
5.575	5.257					

Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
	10000	7.83G	1.849	0.9535	0.8945	86
640: 1	100% 4/4	[00:08<00	:00, 2.23s	/it]		
mAP50	mAP50-9			instances :00:00, 4.2	Box(P Prit/sl	R
		all	6	100	0.939	0.415
0.486	0.2 mi	252 icrocrack	6	1	1	Θ
Θ	0					
0.785	(porosity	6	8	0.937	0.75
ι	unmelted	particle	6	91	0.879	0.495
0.673	0.2	257				
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 80/	10000	7.83G	1.859	0.9312	0.9194	82
640: 1	100% 4/4	[00:08<00	:00, 2.17s	/it]		
mAP50	mΔP50-0	Class 100%:	1/1 [00:00<	Instances 00:00, 2.7	Box(P	R
		all	6	100	0.934	0.426
0.511	0.2 mi		6	1	1	0
0	Θ					
0 800	0.5	porosity	6	8	1	0.727
		particle	6	91	0.802	0.549
0.724	0.2	274				
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 81/	10000	7 83G	1 982	0 926	0.9096	84
640: 1	100% 4/4	[00:07<00	:00, 1.90s	/it]		
mAP50				Instances :00:00, 4.3	Box(P	R
		all	6	100	0.487	0.796
0.657	0.2	283 Lcrocrack	6	1	0.441	1
0.497	0.04		U	1	0.441	1
0.801	0.5	porosity	6	8	0.38	0.75
		particle	6	91	0.64	0.637
0.672						
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 82/	10000	7.83G	1.936	0.8637	0.9404	96
		[00:09<00	:00, 2.29s	/it]		
		Class	Images	Instances	Box (P	R

mAP50	mAP50-95)	: 100% all	1/1 [00:00<		40it/s] 0.619	0.774
0.838	0.339					
0 995	micr 0.144	ocrack	6	1	0.491	1
	ро	rosity	6	8	0.62	0.75
	0.564 nmelted pa		6	91	0.746	0.571
	0.311		J	31	01710	01371
Size		_	_	_	dfl_loss	
		0:08<00	1.844 0:00, 2.11s	s/it]		
mAP50	mAP50-95)	Class: 100%	Images 1/1 [00:00<	Instances 00:00, 2.9	Box(P 92it/s]	R
	0.258	all			0.482	0.781
		ocrack	6	1	0.438	1
	ро	rosity	6	8	0.393	0.75
	0.483 nmelted pa		6	91	0.616	0.593
	0.241		J	J1	0.010	0.333
Size					dfl_loss	
Size 84/	10000	7.83G	1.909	0.9439	dfl_loss 0.9101	
Size 84/ 640: 1	10000 00% 4/4 [0	7.83G 0:07<00 Class	1.909 0:00, 1.93s Images	0.9439 s/it] Instances	0.9101 Box(P	123
Size 84/ 640: 1	10000 00% 4/4 [0 mAP50-95)	7.83G 0:07<00 Class : 100%	1.909 0:00, 1.93s	0.9439 5/it] Instances 500:00, 4.	0.9101 Box(P 50it/s]	123 R
Size 84/ 640: 1 mAP50	10000 00% 4/4 [0 mAP50-95) 0.334	7.83G 0:07<00 Class : 100% all	1.909 0:00, 1.93s Images 1/1 [00:00< 6	0.9439 s/it] Instances :00:00, 4.5	0.9101 Box(P 50it/s] 0.479	123 R 0.799
Size 84/ 640: 1 mAP50	10000 00% 4/4 [0 mAP50-95) 0.334	7.83G 0:07<00 Class : 100% all	1.909 0:00, 1.93s Images 1/1 [00:00< 6	0.9439 s/it] Instances :00:00, 4.5	0.9101 Box(P 50it/s]	123 R
Size 84/ 640: 1 mAP50 0.821 0.995	10000 00% 4/4 [0 mAP50-95) 0.334 micr 0.124	7.83G 0:07<00 Class : 100% all ocrack rosity	1.909 :00, 1.93s Images 1/1 [00:00< 6	0.9439 s/it] Instances :00:00, 4.5	0.9101 Box(P 50it/s] 0.479	123 R 0.799 1
Size 84/ 640: 1 mAP50 0.821 0.995 0.785	10000 00% 4/4 [0 mAP50-95) 0.334 micr 0.124 po 0.581 nmelted pa	7.83G 0:07<00 Class : 100% all ocrack rosity rticle	1.909 :00, 1.93s Images 1/1 [00:00< 6	0.9439 5/it] Instances 500:00, 4.5 100	0.9101 Box(P 50it/s] 0.479	123 R 0.799 1 0.75
Size 84/ 640: 1 mAP50 0.821 0.995 0.785	10000 00% 4/4 [0 mAP50-95) 0.334 micr 0.124 po 0.581 nmelted pa	7.83G 0:07<00 Class : 100% all ocrack rosity rticle	1.909 0:00, 1.93s Images 1/1 [00:00< 6 6	0.9439 s/it] Instances :00:00, 4.! 100	0.9101 Box(P 50it/s] 0.479 0.44 0.397	123 R 0.799 1 0.75
Size 84/ 640: 1 mAP50 0.821 0.995 0.785 u	10000 00% 4/4 [0 mAP50-95) 0.334 micr 0.124 po 0.581 nmelted pa 0.297	7.83G 0:07<00 Class : 100% all ocrack rosity rticle	1.909 0:00, 1.93s Images 1/1 [00:00< 6 6	0.9439 [/it] Instances (00:00, 4.5 100 1 8	0.9101 Box(P 50it/s] 0.479 0.44 0.397 0.6	123 R 0.799 1 0.75
Size 84/ 640: 1 mAP50 0.821 0.995 0.785 u 0.684 Size 85/	10000 00% 4/4 [0 mAP50-95) 0.334 micr 0.124 po 0.581 nmelted pa 0.297 Epoch G	7.83G 0:07<00 Class : 100% all ocrack rosity rticle PU_mem 7.83G	1.909 1.93s Images 1/1 [00:00< 6 6 6 6 box_loss	0.9439 [/it] Instances :00:00, 4.9 100 1 8 91 cls_loss 0.8654	0.9101 Box(P 50it/s] 0.479 0.44 0.397 0.6 dfl_loss	123 R 0.799 1 0.75 0.648
Size 84/ 640: 1 mAP50 0.821 0.995 0.785 u 0.684 Size 85/ 640: 1	10000 00% 4/4 [0 mAP50-95) 0.334 micr 0.124 po 0.581 nmelted pa 0.297 Epoch G	7.83G 0:07<00 Class : 100% all ocrack rosity rticle PU_mem 7.83G 0:08<00 Class	1.909 1.93s Images 1/1 [00:00< 6 6 6 box_loss 1.714 1:00, 2.22s Images	0.9439 [instances	0.9101 Box(P 50it/s] 0.479 0.44 0.397 0.6 dfl_loss 0.9316 Box(P	123 R 0.799 1 0.75 0.648 Instances
Size 84/ 640: 1 mAP50 0.821 0.995 0.785 u 0.684 Size 85/ 640: 1	10000 00% 4/4 [0 mAP50-95) 0.334 micr 0.124 po 0.581 nmelted pa 0.297 Epoch G	7.83G 0:07<00 Class : 100% all ocrack rosity rticle PU_mem 7.83G 0:08<00 Class	1.909 1:00, 1.93s Images 1/1 [00:00< 6 6 6 box_loss 1.714 1:00, 2.22s	0.9439 [instances	0.9101 Box(P 50it/s] 0.479 0.44 0.397 0.6 dfl_loss 0.9316 Box(P	123 R 0.799 1 0.75 0.648 Instances
Size 84/ 640: 1 mAP50 0.821 0.995 0.785 u 0.684 Size 85/ 640: 1	10000 00% 4/4 [0 mAP50-95) 0.334 micr 0.124 po 0.581 nmelted pa 0.297 Epoch G 10000 00% 4/4 [0 mAP50-95) 0.208	7.83G 0:07<00 Class : 100% all ocrack rosity rticle PU_mem 7.83G 0:08<00 Class : 100% all	1.909 1:00, 1.93s Images 1/1 [00:00< 6 6 6 box_loss 1.714 1:00, 2.22s Images 1/1 [00:00< 6	0.9439 i/it] Instances i00:00, 4.5 100 1 cls_loss 0.8654 i/it] Instances i00:00, 4.5 100	0.9101 Box(P 50it/s] 0.479 0.44 0.397 0.6 dfl_loss 0.9316 Box(P Blit/s] 0.781	123 R 0.799 1 0.75 0.648 Instances 64 R 0.415
Size 84/ 640: 1 mAP50 0.821 0.995 0.785 0.684 Size 85/ 640: 1 mAP50	10000 00% 4/4 [0 mAP50-95) 0.334 micr 0.124 po 0.581 nmelted pa 0.297 Epoch G 10000 00% 4/4 [0 mAP50-95) 0.208	7.83G 0:07<00 Class : 100% all ocrack rosity rticle PU_mem 7.83G 0:08<00 Class : 100% all	1.909 1:00, 1.93s Images 1/1 [00:00< 6 6 6 6 box_loss 1.714 1:00, 2.22s Images 1/1 [00:00<	0.9439 [instances and a second color of the	0.9101 Box(P 50it/s] 0.479 0.44 0.397 0.6 dfl_loss 0.9316 Box(P Blit/s]	123 R 0.799 1 0.75 0.648 Instances 64 R

0 643	porosity 0.38	6	8	0.56	0.75
un	melted particle	6	91	0.783	0.495
	0.245				
Size E	poch GPU_mem	box_loss	cls_loss	dfl_loss	Instances
	0000 7.83G 0% 4/4 [00:08<06			0.921	72
	Class	Images	Instances	Box(P	R
		1/1 [00:00<		0.513	0.834
0.837	0.339 microcrack	6	1	0.437	1
0.995	0.199 porosity		8	0.447	0.81
	0.523				
	melted particle 0.297	6	91	0.654	0.692
Е	poch GPU_mem	box loss	cls loss	dfl loss	Instances
Size	0000 7.83G	_	_	_	
	0% 4/4 [00:07<00	0:00, 1.949	s/it]		
mAP50	mAP50-95): 100%	1/1 [00:00<	<00:00, 4.3		
0.383	all 0.186	6	100	0.769	0.372
0	microcrack 0	6	1	1	0
	porosity 0.408	6	8	0.727	0.75
un	melted particle	6	91	0.581	0.365
0.455	0.149				
Size E	poch GPU_mem	box_loss	cls_loss	dfl_loss	Instances
88/1	0000 7.83G 0% 4/4 [00:09<06	1.925	0.8827	0.8755	119
	Class	Images	Instances	Box(P	R
mAP50	mAP50-95): 100% all	1/1 [00:00< 6	<00:00, 4.3 100		0.734
0.775	0.319 microcrack	6	1	0.897	1
0.995	0.217	6	8		
	porosity 0.463			0.532	
un 0.64	melted particle 0.278	6	91	0.755	0.451

						_
Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
	10000	7.83G	1.684	0.8534	0.904	99
640: 1	100% 4/4	[00:08<00	:00, 2.209	s/it]		
mAP50	mΛP50_			Instances 00:00, 4.2	Box(P	R
		all	6	100	0.704	0.665
0.687	0.	233				
0.005	m. 0.		6	1	0.797	1
0.993	0.	porosity	6	8	0.698	0.625
	0.3	342				
	nmelted. 0.	particle	6	91	0.616	0.37
0.4/2	0.	137				
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size	10000	7 83G	1 83	0 9238	0.8744	133
640: 1	100% 4/4	[00:07<00	:00, 1.849	s/it]		
		Class	Images	Instances	Box (P	R
mAP50	MAP50-	95): 100% all	1/1 [00:00<	<00:00, 4.2	0.808	0.650
0.764	0.	406				
	m.	icrocrack	6	1	0.888	1
0.995	0.	49/ norosity	6	8	0.618	0 625
0.674	0.4	458	J	J	0.010	0.025
		particle	6	91	0.918	0.352
0.624	0.	264				
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size	/10000	7 020	1 025	0 0011	0 0222	0.1
			:00, 2.26		0.9233	91
0.0.		Class	Images	Instances	Box(P	R
mAP50	mAP50-	95): 100%	1/1 [00:00<	<00:00, 4.1	L4it/s]	
0.723	0.	all 266	6	100	0.716	0.637
	m.	icrocrack	6	1	0.79	1
0.995	0.	224		0	0.640	0.625
0.715	0.4	porosity 423	6	8	0.649	0.625
U	unmelted	particle	6	91	0.709	0.286
0.458	0	. 15				
	Epoch	GPU mem	box loss	cls loss	dfl loss	Instances
Size	·	_	_	_	_	
	′10000 100% 4/4		1.8:00, 2.229		0.8818	84
040: 1	1000 4/4	Class		Instances	Box(P	R
			». 3 - C		2(.	

mAP50	mAP50-9	05): 100% all	1/1 [00:00		33it/s] 0.694	0.765
0.787	0.3	895	6	1	0.783	1
0.995	0.3					
0.724	0.5	porosity 18	6	8	0.564	0.813
	unmelted 0.2	particle 168	6	91	0.735	0.484
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
			1.813 0:00, 1.84s		0.9186	62
		Class	Images	Instances	Box(P	R
mAP50	mAP50-9	% (100%) all	1/1 [00:00<6	<00:00, 4.6 100	64it/s] 0.914	0.224
0.339	0.1	.69 .crocrack	6	1	1	0
0	0					-
0.644	0.3	porosity 78	6	8	0.904	0.5
ι		particle	6	91	0.839	0.172
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 94	/10000	7.83G	1.836	0.9155	0.9296	48
		[00:08<00	9:00, 2.249	s/it]		
mAP50			1/1 [00:00<	<00:00, 4.3		
0.773		all 38	6	100	0.672	0.712
	mi	.crocrack	6	1	0.757	1
0.995		porosity	6	8	0.464	0.75
0.751		94 particle	6	91	0.796	0.386
0.573			Ü	91	0.790	0.500
Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
95/			1.862 9:00, 2.16		0.8784	133
		Class	Images	Instances	Box(P	R
mAP50		all	1/1 [00:00<6	<00:00, 4.4 100	481t/s] 0.39	0.622
0.433				1	0.265	0.796
	mi	.crocrack	6	1	0.265	0.790
0.332			6	1	0.205	0.790

Dorosity 6 8 0.464 0.75							
unmelted particle 0.347 0.105 Epoch GPU_mem box_loss cls_loss dfl_loss Instances	0 621	o 3	porosity	6	8	0.464	0.75
Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size 96/10000 7.83G 2.059 0.9587 0.8815 181 640: 100% 4/4 [00:07<00:00, 1.82s/it]				6	91	0 441	0 32
Size 96/10000 7.83G 2.059 0.9587 0.8815 181 640: 100% 4/4 [00:07-00:00, 1.825/it] Class Images Instances Box(P R MAP50 MAP50-95): 100% 1/1 [00:00-00:00, 4.48it/s] all 6 100 0.797 0.742 0.784 0.459 microcrack 6 1 0.86 1 0.995 0.597 porosity 6 8 0.615 0.75 0.708 0.507 unmelted particle 6 91 0.916 0.476 0.649 0.273 Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size 97/10000 7.83G 1.976 0.8915 0.8649 73 640: 100% 4/4 [00:08-00:00, 2.225/it] Class Images Instances Box(P R MAP50 MAP50-95): 100% 1/1 [00:00<00:00, 4.61it/s] all 6 100 0.377 0.495 0.449 0.213 microcrack 6 1 0 0 0.00765 0.000765 porosity 6 8 0.485 0.827 0.666 0.226 Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size 98/10000 7.83G 1.837 0.8652 0.8927 58 640: 100% 4/4 [00:08-00:00, 2.125/it] Class Images Instances Box(P R MAP50 MAP50-95): 100% 1/1 [00:00<00:00, 4.61it/s] all 6 100 0.377 0.495 0.675 0.413 unmelted particle 6 91 0.645 0.659 0.666 0.226 Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size 98/10000 7.83G 1.837 0.8652 0.8927 58 640: 100% 4/4 [00:08-00:00, 2.125/it] Class Images Instances Box(P R MAP50 MAP50-95): 100% 1/1 [00:00<00:00, 3.03it/s] all 6 100 0.64 0.848 0.783 0.389 microcrack 6 1 0.973 1 0.995 0.398 porosity 6 8 0.386 0.875 0.704 0.503 unmelted particle 6 91 0.561 0.67				0	51	0.441	0.52
96/10000 7.83G 2.059 0.9587 0.8815 181 640: 100% 4/4 [00:07<00:00] 1.82s/it] Class Images Instances Box(P R mAP50 mAP50-95): 100% 1/1 [00:00<00:00] 4.48it/s] all 6 100 0.797 0.742 0.784 0.459 0.784 0.459 microcrack 6 1 0.86 1 0.995 0.597 porosity 6 8 0.615 0.75 0.708 0.507 unmelted particle 6 91 0.916 0.476 0.649 0.273 Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size 97/10000 7.83G 1.976 0.8915 0.8649 73 640: 100% 4/4 [00:08<00:00] 2.22s/it] Class Images Instances Box(P R mAP50 mAP50-95): 100% 1/1 [00:00<00:00] 4.61it/s] all 6 100 0.377 0.495 0.449 0.213 microcrack 6 1 0 0 0.00765 0.000765 porosity 6 8 0.485 0.827 0.675 0.413 unmelted particle 6 91 0.645 0.659 0.666 0.226 Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size 98/10000 7.83G 1.837 0.8652 0.8927 58 640: 100% 4/4 [00:08<00:00] 2.12s/it] Class Images Instances Box(P R mAP50 mAP50-95): 100% 1/1 [00:00<00:00] 3.03it/s] all 6 100 0.64 0.848 0.783 0.389 microcrack 6 1 0.973 1 0.995 0.398 porosity 6 8 0.386 0.875 0.704 0.503 unmelted particle 6 91 0.561 0.67		Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Class	96/					0.8815	181
0.784			Class	Images	Instances		R
0.784	mAP50	mAP50-9					0.742
0.995	0.784		459		1	0.06	1
0.708	0.995			0	1	0.80	T
unmelted particle 6 91 0.916 0.476 0.649 0.273 Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size 97/10000 7.83G 1.976 0.8915 0.8649 73 640: 100% 4/4 [00:08<00:00, 2.22s/it] Class Images Instances Box(P R mAP50 mAP50-95): 100% 1/1 [00:00<00:00, 4.61it/s] all 6 100 0.377 0.495 0.449 0.213 microcrack 6 1 0 0 0.377 0.495 0.00765 0.000765 porosity 6 8 0.485 0.827 0.675 0.413 unmelted particle 6 91 0.645 0.659 0.666 0.226 Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size 98/10000 7.83G 1.837 0.8652 0.8927 58 640: 100% 4/4 [00:08<00:00, 2.12s/it] Class Images Instances Box(P R mAP50 mAP50-95): 100% 1/1 [00:00<00:00, 3.03it/s] all 6 100 0.64 0.848 0.783 0.389 microcrack 6 1 0.973 1 0.995 0.398 porosity 6 8 0.386 0.875 0.704 0.503 unmelted particle 6 91 0.561 0.67	0 708			6	8	0.615	0.75
Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size 97/10000 7.83G 1.976 0.8915 0.8649 73 640: 100% 4/4 [00:08<0:00, 2.22s/it]	u	nmelted	particle	6	91	0.916	0.476
Size 97/10000 7.83G 1.976 0.8915 0.8649 73 640: 100% 4/4 [00:08<00:00, 2.22s/it] Class Images Instances Box(P R MAP50 mAP50-95): 100% 1/1 [00:00<00:00, 4.61it/s] all 6 100 0.377 0.495 0.449 0.213 microcrack 6 1 0 0 0.00765 0.000765 porosity 6 8 0.485 0.827 0.675 0.413 unmelted particle 6 91 0.645 0.659 0.666 0.226 Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size 98/10000 7.83G 1.837 0.8652 0.8927 58 640: 100% 4/4 [00:08<00:00, 2.12s/it] Class Images Instances Box(P R MAP50 mAP50-95): 100% 1/1 [00:00<00:00, 3.03it/s] all 6 100 0.64 0.848 0.783 0.389 microcrack 6 1 0.973 1 0.995 0.398 porosity 6 8 0.386 0.875 0.704 0.503 unmelted particle 6 91 0.561 0.67	0.649	0.2	273				
97/10000 7.83G 1.976 0.8915 0.8649 73 640: 100% 4/4 [00:08<00:00, 2.22s/it]		Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Class Images Instances Box(P R MAP50 MAP50-95): 100% 1/1 [00:00<00:00, 4.61it/s] all 6 100 0.377 0.495 0.449 0.213	97/					0.8649	73
mAP50 mAP50-95): 100% 1/1 [00:00<00:00, 4.61it/s] all 6 100 0.377 0.495 0.449 0.213 microcrack 6 1 0 0 0.00765 0.000765 porosity 6 8 0.485 0.827 0.675 0.413 unmelted particle 6 91 0.645 0.659 0.666 0.226 Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size 98/10000 7.83G 1.837 0.8652 0.8927 58 640: 100% 4/4 [00:08<00:00, 2.12s/it] Class Images Instances Box(P R mAP50 mAP50-95): 100% 1/1 [00:00<00:00, 3.03it/s] all 6 100 0.64 0.848 0.783 0.389 microcrack 6 1 0.973 1 0.995 0.398 porosity 6 8 0.386 0.875 0.704 0.503 unmelted particle 6 91 0.561 0.67	640: 1	00% 4/4				Box (P	R
0.449	mAP50	mAP50-9	95): 100%	1/1 [00:00	<00:00, 4.6	61it/s]	
0.00765	0.449	0.2	213	6	100	0.3//	0.495
porosity 6 8 0.485 0.827 0.675 0.413 unmelted particle 6 91 0.645 0.659 0.666 0.226 Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size 98/10000 7.83G 1.837 0.8652 0.8927 58 640: 100% 4/4 [00:08<00:00, 2.12s/it] Class Images Instances Box(P R mAP50 mAP50-95): 100% 1/1 [00:00<00:00, 3.03it/s] all 6 100 0.64 0.848 0.783 0.389 microcrack 6 1 0.973 1 0.995 0.398 porosity 6 8 0.386 0.875 0.704 0.503 unmelted particle 6 91 0.561 0.67	0 0076			6	1	0	0
unmelted particle 6 91 0.645 0.659 0.666 0.226 Epoch GPU_mem box_loss cls_loss dfl_loss Instances Size 98/10000 7.83G 1.837 0.8652 0.8927 58 640: 100% 4/4 [00:08<00:00, 2.12s/it] Class Images Instances Box(P R MAP50 mAP50-95): 100% 1/1 [00:00<00:00, 3.03it/s] all 6 100 0.64 0.848 0.783 0.389 microcrack 6 1 0.973 1 0.995 0.398 porosity 6 8 0.386 0.875 0.704 0.503 unmelted particle 6 91 0.561 0.67			porosity	6	8	0.485	0.827
0.666				6	01	0 6/5	A 650
Size 98/10000 7.83G 1.837 0.8652 0.8927 58 640: 100% 4/4 [00:08<00:00, 2.12s/it] Class Images Instances Box(P R MAP50 MAP50-95): 100% 1/1 [00:00<00:00, 3.03it/s] all 6 100 0.64 0.848 0.783 0.389 microcrack 6 1 0.973 1 0.995 0.398 porosity 6 8 0.386 0.875 0.704 0.503 unmelted particle 6 91 0.561 0.67				O	91	0.043	0.039
98/10000 7.83G 1.837 0.8652 0.8927 58 640: 100% 4/4 [00:08<00:00, 2.12s/it]		Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Class Images Instances Box(P R mAP50 mAP50-95): 100% 1/1 [00:00<00:00, 3.03it/s] all 6 100 0.64 0.848 0.783 0.389 microcrack 6 1 0.973 1 0.995 0.398 porosity 6 8 0.386 0.875 0.704 0.503 unmelted particle 6 91 0.561 0.67		10000	7.83G	1.837	0.8652	0.8927	58
mAP50 mAP50-95): 100% 1/1 [00:00<00:00, 3.03it/s]	640: 1	00% 4/4	_			Pov/P	D
0.783	mAP50	mAP50-9	95): 100%	1/1 [00:00	<00:00, 3.0	03it/s]	
microcrack 6 1 0.973 1 0.995 0.398	0.783	Θ. 3		6	100	0.64	0.848
porosity 6 8 0.386 0.875 0.704 0.503		m	icrocrack	6	1	0.973	1
0.704 0.503 unmelted particle 6 91 0.561 0.67	0.995	Θ		6	8	0.386	0.875
				6	0.1	ი 561	a 67
			•	0	91	0.501	0.07

	Fnoch	GPII mem	hox loss	cls loss	dfl loss	Instances
Size	-	_	_	_	_	
99/	10000	7.83G	1.833 :00, 1.86s	0.7918	0.8764	69
		Class	Images	Instances	Box(P	R
mAP50	mAP50-9	95): 100% all	1/1 [00:00<	<00:00, 4.2	21it/s] 0.745	0 411
0.439	0.2	226				0.411
Θ	mi O	icrocrack	6	1	1	0
		porosity	6	8	0.489	0.75
	0.4 0.4	433 particle	6	91	0.746	0.484
	0.2		O	91	0.740	0.404
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 100/	10000	7.83G	1.833	0.87	0.9163	53
640: 1	.00% 4/4	[00:08<00	:00, 2.169	s/it]		
mAP50	mAP50-9	05): 100%	1/1 [00:00<	instances 4.4 <00:00,	Box(P H3it/s]	R
		all	6	100	0.787	0.448
	0.3 mi	icrocrack	6	1	1	0
0.497	0.2	249	6	0	0 524	0.75
0.736	0.4	porosity 495	6	8	0.534	0.75
U	ınmelted	particle	6	91	0.827	0.593
0.7	0.287	/				
Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
101/					0.8589	34
640: 1	.00% 4/4	[00:08<00	:00, 2.08s	s/it]	Box(P	R
mAP50	mAP50-9	95): 100%	1/1 [00:00<	<00:00, 2.9	94it/s]	
0.747	0.7	all 256	6	100	0.628	0.459
0.747		icrocrack	6	1	1	0
0.995	0	.11 porosity	6	8	0.323	0.75
0.66	0.43		U	0	0.323	0.75
0.587	nmelted 0.2	particle	6	91	0.562	0.626
0.367	0.2	222				
Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
102/	10000	7.83G	1.848		0.9079	72
640: 1	.00% 4/4	[00:07<00 Class	:00, 1.79s Images		Box (P	R
		0.000	1	5 ca665	23/(1	, ,

mAP50 mA		100% all		<00:00, 4.1 100	16it/s] 0.479	0 821
0.829	0.476					
0.995	micro	crack	6	1	0.501	1
	por	osity	6	8	0.338	0.75
0.787 unme	0.515 lted par	ticle	6	91	0.598	0.714
0.705	0.316					
Epo Size	ch GPI	J_mem	box_loss	cls_loss	dfl_loss	Instances
103/100			1.793 9:00, 2.14s		0.8697	99
		Class	Images	Instances	Box(P	R
	P50-95):			4.!<00:00, 4.! 100	0.419	0.382
0.457	0.208					
0.166	micro 0.0498	сгаск	6	1	0	0
0.668	por	osity	6	8	0.545	0.749
unme	lted par	ticle	6	91	0.712	0.396
0.538	0.188					
Epo Size	ch GPI	U_mem	box_loss	cls_loss	dfl_loss	Instances
104/100	00 4/4 [00	7.83G :07<00	1.736 9:00, 1.94s	0.8681	0.8883	65
		Class	Images	Instances	Box(P	R
MAP50 MA		100% all		<00:00, 2.9 100	961t/s] 0.747	0.708
0.822	0.29 micro		6	1	0.481	1
0.995	0.107	CIACK	O		0.401	T
0.782	por 0.479	osity	6	8	0.815	0.75
unme	lted par	ticle	6	91	0.944	0.373
0.69	0.284					
Epo Size	ch GPI	J_mem	box_loss	cls_loss	dfl_loss	Instances
105/100 640: 100%	00 4/4 [00	7.83G :07<00	1.9 9:00, 1.95	0.8721 s/it]	0.8795	99
		Class	Images	Instances		R
		all	6	<00:00, 4.2 100		0.591
0.74	0.231 micro	crack	6	1	0.849	1
0.995	0.0995			_		_

0.668	0.3	porosity	6	8	0.564	0.5
		particle	6	01	0.961	0.274
0.558			U	91	0.901	0.274
F	nach	GDII mam	hov loss	cle loss	dfl loss	Instances
Size	росп	or o_illelii	007_0033	Ct3_t033	u1 t_t033	Tilstalices
			1.658 0:00, 2.20		0.863	71
		Class	Images	Instances	Box(P	R
mAP50	mAP50-9			<00:00, 4.4 100	41it/s] 0.779	0.649
0.802		345				
0.995	mi 0.2	.crocrack	6	1	0.818	1
		porosity	6	8	0.683	0.5
0.72 un		garticle	6	91	0.836	0.448
0.69						
	poch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size	0000	7 000	1 701		0.0054	150
-			1./81 0:00, 2.01		0.8654	158
		Class	Images	Instances	Box(P	R
mAP50	mAP50-9			<00:00, 2.9 100	99it/s] 0.723	0.68
0.8						
0.995	mi 0.1	.crocrack	6	1	0.588	1
0.993		porosity	6	8	0.738	0.625
0.769	0.4	52		_		
un 0.635		particle 245	6	91	0.843	0.414
	poch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size	0000	7 020	1 7/0	0 0551	0 0705	O.E.
			1.746 1.91):00	0.8551 s/it]	0.8795	85
		Class		Instances		R
mAP50	mAP50-9	95): 100% all	1/1 [00:00	<00:00, 3.9 100		0.763
0.787	0.3					
0.995	mi 0.3	.crocrack	6	1	0.867	1
0.995	0.5	porosity	6	8	0.612	0.75
0.726		47	_	0.7	0.644	0 530
un 0.64	melted 0.28	particle 4	6	91	0.644	0.538

	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 109/	10000	7.83G	1.811	0.8506	0.8618	50
		[00:09<00	:00, 2.269	s/it]		
mAP50	mAP50-9	95): 100%	1/1 [00:00<	<00:00, 4.4	Box(P 44it/s]	
	0.2	all	6	100	0.767	0.693
0.784		icrocrack	6	1	0.909	1
0.995	0.1	L49		8	0 555	0.625
0.721	0.4	porosity 191	0	ō	0.555	0.625
	nmelted 0.2	particle 254	6	91	0.838	0.453
Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
110/					0.8744	47
640: 1	.00% 4/4	[00:07<00	:00, 1.86s	[/it]	Box(P	R
mAP50	mAP50-9	95): 100%	1/1 [00:00<	<00:00, 2.9	95it/s]	
0.772	0.3	all 337	6	100	0.752	0.717
	mi	icrocrack	6	1	0.8	1
0.995	0.3	porosity	6	8	0.614	0.625
	0 .	. 35		0.1	0.042	0 526
	inmetted 0.2	particle 295	6	91	0.842	0.526
	Enoch	GPII mem	hox loss	cls loss	dfl_loss	Instances
Size	-	_	_	_	_	
			1.767 :00, 2.03s		0.88	80
		Class	Images	Instances	Box(P	R
mAP50	mAP50-9	95): 100% all	1/1 [00:00<	<00:00, 4.4 100	121t/s] 0.502	0.815
0.829	0.4	129				
0.995	m: 0.3	icrocrack 398	6	1	0.44	1
0.784	0.5	porosity	6	8	0.408	0.75
		particle	6	91	0.657	0.696
0.709	0.2	296				
Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
112/	10000	7.83G	1.821		0.8777	97
640: 1	.00% 4/4	[00:09<00 Class	:00, 2.29s Images		Box(P	R
		0.400	4900	12 10	23/((. ,

mAP50		5): 100% all		<00:00, 4.2 100	24it/s] 0.58	0.807
0.816	0.3		6	1	0.73	1
0.995	0.3	09				
0.726	0.4	porosity 89	6	8	0.367	0.75
	unmelted 0.3	particle 01	6	91	0.644	0.67
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
				0.8343	0.8699	63
640: 1	100% 4/4		:00, 2.18s		Box(P	R
mAP50	mAP50-9	5): 100%		<00:00, 2.6		
0.769	0.3	11				
0.995	mi 0.1	crocrack 99	6	1	0.968	1
		porosity	6	8	0.373	0.75
ι	unmelted	particle	6	91	0.604	0.653
0.633	0.2	57				
Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
			1.716 :00, 1.92s		0.8821	114
		Class	Images		Box(P	R
		all	6	100	0.576	0.77
		crocrack	6	1	0.793	1
0.995	0.3	98 porosity	6	8	0.337	0.75
0.698	0.4	69				
0.589	unmelted 0.2		6	91	0.599	0.56
Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
115/	10000 100% 4/4	7.83G	1.744 :00, 2.35s	0.8346	0.8769	82
		Class	Images	Instances		R
mAP50		all	1/1 [00:00< 6	<00:00, 4.2 100	25it/s] 0.508	0.781
0.778	0.3 mi	65 crocrack	6	1	0.572	1
0.995	0.3					

0.735	porosity	6	8	0.376	0.75
unmel	ted particle	6	91	0.575	0.593
0.606					
Epoc Size	ch GPU_mem	box_loss	cls_loss	dfl_loss	Instances
	00 7.83G 4/4 [00:08<00			0.9023	49
	Class	Images	Instances	Box(P	R
	250-95): 100% all	6		0.893	0.334
0.445	0.238 microcrack	6	1	1	0
0	0 porosity		8	0.759	0.625
0.695	0.476				
0.64	ted particle 0.238	6	91	0.92	0.378
Epoc	ch GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 117/1000	7.83G	1.74	0.8584	0.8918	128
640: 100%	4/4 [00:07<00	9:00, 1.869	s/it]	Box (P	
mAP50 mAP	950-95): 100%	1/1 [00:00<	<00:00, 4.3	30it/s]	
0.64				0.92	0.404
0.497	microcrack 0.0498	6	1	1	0
	porosity	6	8	0.853	0.729
unmel	ted particle	6	91	0.906	0.484
0.642				167. 7	
Size	ch GPU_mem	box_loss	cls_loss	dfl_loss	Instances
118/1000 640: 100%	00 7.83G 4/4 [00:09<00	1.825 9:00. 2.30s	0.8769 s/itl	0.8882	125
	Class 250-95): 100%	Images	Instances	Box(P	R
	all	6			0.333
0.42	0.24 microcrack	6	1	0	0
0	0 porosity	6	8	0.669	0.625
0.736		6	91		
0.523	0.224	U	91	0.73	0.374

	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 119/	10000	7.83G	1.723	0.8636	0.8987	74
		[00:08<00	:00, 2.01s	/it]		
mAP50	mAP50-0	Class 100% : 100%	1/1 [00:00<	Instances :00:00, 3.0	Box(P	R
		all	6	100	0.614	0.804
0.83	0.34		6	1	0.761	1
0.995	0.1			T	0.701	1
0.010	0.5	porosity	6	8	0.501	0.75
		particle	6	91	0.578	0.662
	0					
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size	10000	7 936	1 650	0.70	0.8829	54
640: 1	00% 4/4	[00:07<00	:00, 1.79s	/it]		
		Class	Images	Instances	Box (P	R
MAP50	MAP50-9	95): 100% all	>00:001 6	:00:00, 4.5 100	0.601	0.748
0.759	0.3	321				
0.995	m: 0.3		6	Ţ	0.77	1
		porosity	6	8	0.382	0.75
	0.3	351 particle	6	91	0.65	0.495
	0.2		U	31	0.03	0.433
	Fnoch	GPII mem	hox loss	cls loss	dfl_loss	Instances
Size		_	_	_	_	
			1.729 :00, 2.17s		0.8926	131
040: 1	.00% 4/4	Class	Images	Instances	Box (P	R
mAP50		95): 100%	1/1 [00:00<	00:00, 4.3	86it/s]	
0.755	0.3	all 311	6	100	0.545	0.86
		icrocrack	6	1	0.722	1
0.995	0.2	298 porosity	6	8	0.356	0.875
0.622	0.3	363				
u 0.648		particle 272	6	91	0.557	0.706
						_
Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
122/	10000	7.83G	1.671	0.8514	0.9005	61
640: 1	00% 4/4	[00:08<00 Class	:00, 2.04s	/it] Instances	Box (P	R
		Class	Illiages	TIIS CALICES	DUX (P	Λ

mAP50		: 100% all	1/1 [00:00<		96it/s] 0.673	0 503
0.77		acc				0.505
0 005	micr 0.398		6	1	1	Θ
	ро	rosity	6	8	0.459	0.849
	0.325 nmelted pa		6	01	0.561	0.659
	0.246		U	31	0.501	0.033
Size					dfl_loss	
		0:07<00):00, 1.87s	s/it]	0.8664	
mAP50		: 100%	1/1 [00:00<	00:00, 4.		
0.782			6	100	0.479	0.832
		ocrack	6	1	0.492	1
	ро	rosity	6	8	0.341	0.778
	0.414 nmelted pa		6	91	0.603	0.719
0.71	0.326					
Size	Epoch G	PU_mem	box_loss	cls_loss	dfl_loss	Instances
124/ 640: 1	10000 00% 4/4 [0	7.83G 0:08<00	1.74):00, 2.15s	0.8408 5/it]	0.8833	86
mAP50	mAP50-95)		Images 1/1 [00:00<		Box(P 44it/s]	R
0.712	0.28	all	6	100	0.705	0.722
0.995		ocrack	6	1	0.899	1
	ро	rosity	6	8	0.537	0.75
0.545 u	0.327 nmelted pa		6	91	0.677	0.415
0.595				<u> </u>		01.120
Size	Epoch G	PU_mem	box_loss	cls_loss	dfl_loss	Instances
			1.717 0:00, 2.07s		0.8854	66
mAP50		Class		Instances	Box(P	R
		all	6	100		0.763
0.772	0.371 micr	ocrack	6	1	0.904	1
0.995	0.398		· ·	-	0.001	_

0.620	0.4	porosity	6	8	0.533	0.75
		particle	6	01	0.841	0.538
	0.2		U	31	0.041	0.550
	Epoch	GPU mem	box loss	cls loss	dfl loss	Instances
Size	•	_	_	_	_	
			1.882 9:00, 1.889		0.8692	114
		Class	Images	Instances	Box(P	R
mAP50	mAP50-9			<00:00, 4.3 100	38it/s] 0.766	0.699
0.761	0.4	121	O .	100	0.700	0.033
0.995	mi 0.6	crocrack	6	1	0.89	1
		porosity	6	8	0.575	0.625
	0.	32 particle	6	01	0.834	0 173
	0.2		U	91	0.034	0.475
	Enach	CDII mom	hay loss	ole less	dfl loss	Instances
Size	Еросп	GPU_IIIEIII	DOX_1055	Cts_t0ss	dfl_loss	Tilstalices
-					0.8641	56
640: 1	00% 4/4		0:00, 2.319 Tmages		Box(P	R
mAP50	mAP50-9	95): 100%	1/1 [00:00	<00:00, 4.2	24it/s]	
0 771	0.3	all	6	100	0.751	0.675
0.771		crocrack	6	1	0.896	1
0.995	0.3			0	0 404	0.5
0 585	0.4	porosity เดร	6	8	0.484	0.5
		particle	6	91	0.872	0.524
0.733	0.2	285				
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size	10000	7 020	1 606	0 0416	0 0622	F 1
-			1.080	0.8416 s/itl	0.8622	51
		Class	Images	Instances	Box(P	R
mAP50	mAP50-9	95): 100% all	1/1 [00:00-6	00:00, 2.9 100	96it/s] 0.64	0.632
0.717	0.3		U	100	0.04	0.032
0 005		Lcrocrack	6	1	0.521	1
0.995	0.3	porosity	6	8	0.612	0.5
0.569	0.3	333		0.7		
u 0.586		particle 214	6	91	0.787	0.396

	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	
Size	10000	7 936	1 900	0 0066	0.8799	79	
		[00:07<00	:00, 1.97s	/it]			
		Class	Images	Instances	Box(P	R	
mAP50	mAP50-9	95): 100% all	1/1 [00:00<	.00:00, 4.2 100	221t/s] 0.588	0 632	
0.532	0.2	259					
0 222	mi	crocrack	6	1	0.279	1	
0.332	0.1		6	8	0.57	0.5	
	0.3	344					
0.717	nmelted 0.3	particle 312	6	91	0.913	0.396	
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	
					0.8454	140	
640: I	00% 4/4	[00:08<00 Class	:00, 2.24s Images	[/it] Instances	Box(P	R	
mAP50	mAP50-9	95): 100%	1/1 [00:00<	00:00, 4.1	l9it/s]		
0.533	0.7)11			0.63	0.5/2	
0.000	mi	crocrack	6	1	0.312	1	
0.497	0.1	l66 norosity	6	Ω	0.736	0.354	
0.48	0.27	74	0	U	0.750	0.354	
น ค. 621	nmelted 0.1	particle	6	91	0.841	0.363	
Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	
131/	10000	7.83G	1.78	0.8609	0.8611	109	
640: 1	00% 4/4	[00:07<00	:00, 1.94s	/it]	D (D	5	
mAP50	mAP50-9		1mages 1/1 [00:00<		Box(P S0it/sl	R	
		all	6	100	0.775	0.717	
0.756	0.4	129 Lcrocrack	6	1	0.883	1	
0.995	0.5		0	_	0.005	1	
0 F61	0. 7	porosity	6	8	0.555	0.625	
0.561 u	0.3 nmelted	particle	6	91	0.889	0.526	
0.711	0.3						
Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	
132/	10000		1.756		0.891	73	
640: 1	00% 4/4		:00, 1.96s		Day/D	D	
		Class	Images	Instances	Box(P	R	

mAP50	mAP50-95)	: 100%	1/1 [00:00<	<00:00, 4.2	29it/s]	
0.721	0.275	all	6	100	0.708	0.692
	micr	ocrack	6	1	0.884	1
		rosity	6	8	0.512	0.625
	0.324 nmelted pa		6	91	0.729	0.451
	0.199			31	01725	01.151
Size	Epoch G	PU_mem	box_loss	cls_loss	dfl_loss	Instances
133/3					0.8674	153
		Class	:00, 2.27s	Instances	Box(P	R
mAP50	mAP50-95)	: 100%		<00:00, 4.2	25it/s] 0.668	0.717
0.772	0.413					
0.995	micr 0.497	ocrack	6	1	0.848	1
		rosity	6	8	0.406	0.625
ur	nmelted pa	rticle	6	91	0.752	0.527
0.689	0.314					
Size	Epoch G	PU_mem	box_loss	cls_loss	dfl_loss	Instances
134/	10000	7.83G	1.657 :00, 2.07s	0.7835	0.8745	69
		Class	Images	Instances	Box(P	R
mAP50				<00:00, 3.0 100	0.615	0.654
0.758	0.318		6		0.333	1
0.995	0.298					_
0.616		rosity	6	8	0.511	0.625
ur 0.664	nmelted pa	rticle	6	91	1	0.338
				, ,	163 3	
Size	Epoch G	PU_mem	DOX_LOSS	cts_toss	dfl_loss	Instances
			1.696 :00, 1.979	0.8378 s/i+1	0.8774	52
		Class	Images	Instances		R
		all	6	<00:00, 4.3 100		0.424
0.776	0.413 micr	ocrack	6	1	1	0
0.995	0.497					

0.62						
0.02	0 43	porosity	6	8	0.39	0.625
				0.1	0.67	0.640
		particle	6	91	0.67	0.648
0./11	0.3	309				
	Enach	CDII mom	hov loss	cle less	dfl loss	Instances
Size	Еросп	GPU_IIIEIII	DOX_LOSS	0.055	011_1055	Tilstalices
	10000	7 836	1 671	0 7662	0.8677	106
			0:00, 2.25		0.0077	100
040. 1	.00% 4/4	Class	Tmages	Inctances	Box(P	R
mAP50	mΔP50-0			<00:00, 4.		IX
וותו סט	IIIAI 30-3				0.48	0.654
0 526	0.2	230	U	100	0.40	0.054
0.520		crocrack	6	1	0.281	0.842
0 332	0.09		J	-	01201	01012
0.552		porosity	6	8	0.411	0.625
0.599	0.3		J	J	01111	0.025
		particle	6	91	0.748	0.495
	0.2		-	-		0.1.00
	0.1					
	Epoch	GPU mem	box loss	cls loss	dfl_loss	Instances
Size	•	_	_	_	_	
137/	10000	7.83G	1.562	0.7132	0.8699	74
640: 1	.00% 4/4		0:00, 1.90			
					Box (P	R
mAP50	mAP50-9	95): 100%	1/1 [00:00	<00:00, 3.	05it/s]	
		all	6	100	0.663	0.739
0.788	0.3					
		Lcrocrack	e	1	0.82	
0.995			6		0.02	1
0.555		398				
		98 porosity		8		
0.711	e	398 porosity).5	6	8	0.459	0.625
0.711 U	0 Inmelted	398 porosity 0.5 particle			0.459	0.625
0.711 U	e	398 porosity 0.5 particle	6	8	0.459	0.625
0.711 U	0.2	porosity).5 particle 291	6	8 91	0.459 0.711	0.625 0.593
0.711 0.656	0.2	porosity).5 particle 291	6	8 91	0.459	0.625 0.593
0.711 0.656 Size	onmelted 0.2 Epoch	398 porosity).5 particle 291 GPU_mem	6 box_loss	8 91 cls_loss	0.459 0.711 dfl_loss	0.625 0.593 Instances
0.711 0.656 Size 138/	inmelted 0.2 Epoch	398 porosity 0.5 particle 291 GPU_mem 7.83G	6 6 box_loss 1.678	8 91 cls_loss 0.7819	0.459 0.711 dfl_loss	0.625 0.593
0.711 0.656 Size 138/	inmelted 0.2 Epoch	398 porosity).5 particle 291 GPU_mem 7.83G [00:07<06	6 box_loss 1.678 0:00, 1.969	8 91 cls_loss 0.7819 s/it]	0.459 0.711 dfl_loss 0.8844	0.625 0.593 Instances 45
0.711 0.656 Size 138/ 640: 1	0.2 Inmelted 0.2 Epoch (10000 .00% 4/4	398 porosity).5 particle 291 GPU_mem 7.83G [00:07<06	6 box_loss 1.678 0:00, 1.969 Images	8 91 cls_loss 0.7819 s/it] Instances	0.459 0.711 dfl_loss 0.8844 Box(P	0.625 0.593 Instances
0.711 0.656 Size 138/	0.2 Inmelted 0.2 Epoch (10000 .00% 4/4	398 porosity).5 particle 291 GPU_mem 7.83G [00:07<06 Class 95): 100%	6 box_loss 1.678 0:00, 1.969 Images 1/1 [00:00	8 91 cls_loss 0.7819 s/it] Instances <00:00, 4.	0.459 0.711 dfl_loss 0.8844 Box(P 32it/s]	0.625 0.593 Instances 45
0.711 0.656 Size 138/ 640: 1	0.2 Inmelted 0.2 Epoch (10000 .00% 4/4 mAP50-9	398 porosity).5 particle 291 GPU_mem 7.83G [00:07<06 Class 95): 100% all	6 box_loss 1.678 0:00, 1.969 Images	8 91 cls_loss 0.7819 s/it] Instances	0.459 0.711 dfl_loss 0.8844 Box(P 32it/s]	0.625 0.593 Instances 45
0.711 0.656 Size 138/ 640: 1	0.2 Inmelted 0.2 Epoch (10000 .00% 4/4 mAP50-9	398 porosity).5 particle 291 GPU_mem 7.83G [00:07<06 Class 95): 100% all	6 box_loss 1.678 0:00, 1.969 Images 1/1 [00:00-	8 91 cls_loss 0.7819 s/it] Instances <00:00, 4.3	0.459 0.711 dfl_loss 0.8844 Box(P 32it/s] 0.659	0.625 0.593 Instances 45 R 0.707
0.711 0.656 Size 138/ 640: 1 mAP50 0.768	0.2 Inmelted 0.2 Epoch (10000 .00% 4/4 MAP50-9	398 porosity).5 particle 291 GPU_mem 7.83G [00:07<06 Class 05): 100% all 36	6 box_loss 1.678 0:00, 1.969 Images 1/1 [00:00	8 91 cls_loss 0.7819 s/it] Instances <00:00, 4.	0.459 0.711 dfl_loss 0.8844 Box(P 32it/s]	0.625 0.593 Instances 45
0.711 0.656 Size 138/ 640: 1	0.2 Inmelted 0.2 Epoch (10000 .00% 4/4 MAP50-9	398 porosity).5 particle 291 GPU_mem 7.83G [00:07<06 Class 05): 100% all 36 crocrack	6 box_loss 1.678 0:00, 1.969 Images 1/1 [00:00-6	8 91 cls_loss 0.7819 s/it] Instances <00:00, 4.1	0.459 0.711 dfl_loss 0.8844 Box(P 32it/s] 0.659 0.902	0.625 0.593 Instances 45 R 0.707
0.711 0.656 Size 138/ 640: 1 mAP50 0.768	0.2 Inmelted 0.2 Epoch 10000 .00% 4/4 mAP50-9 0.	398 porosity).5 particle 291 GPU_mem 7.83G [00:07<06 Class 95): 100% all 36 crocrack 298 porosity	6 box_loss 1.678 0:00, 1.969 Images 1/1 [00:00-	8 91 cls_loss 0.7819 s/it] Instances <00:00, 4.3	0.459 0.711 dfl_loss 0.8844 Box(P 32it/s] 0.659	0.625 0.593 Instances 45 R 0.707
0.711 0.656 Size 138/ 640: 1 mAP50 0.768 0.995 0.693	0.2 Inmelted 0.2 Epoch (10000 .00% 4/4 mAP50-9 0. mi 0.2	398 porosity).5 particle 291 GPU_mem 7.83G [00:07<06 Class 95): 100% all 36 crocrack 298 porosity 516	6 box_loss 1.678 0:00, 1.969 Images 1/1 [00:00-6	8 91 cls_loss 0.7819 s/it] Instances <00:00, 4.1	0.459 0.711 dfl_loss 0.8844 Box(P 32it/s] 0.659 0.902 0.471	0.625 0.593 Instances 45 R 0.707 1
0.711 0.656 Size 138/ 640: 1 mAP50 0.768 0.995 0.693	mAP50-9 mi 0.2	porosity).5 particle 291 GPU_mem 7.83G [00:07<06 Class 05): 100% all 36 crocrack 298 porosity 516 particle	6 box_loss 1.678 0:00, 1.969 Images 1/1 [00:00-6	8 91 cls_loss 0.7819 s/it] Instances <00:00, 4.3 100	0.459 0.711 dfl_loss 0.8844 Box(P 32it/s] 0.659 0.902 0.471	0.625 0.593 Instances 45 R 0.707 1

	Epoch	GPU mem	box loss	cls loss	dfl loss	Instances
Size		7 020	1 676	0 700	0.8746	106
		[00:08<00	:00, 2.179	s/it]		
mAD50	mΛD50_0	Class	Images	Instances 4.4 ,00:00	Box(P	R
		all	6	100	0.688	0.741
0.813	0.3 m	372 icrocrack	6	1	0.984	1
0.995	0.7	298				
0.799	0.	porosity 543	6	8	0.461	0.642
U	ınmelted	particle	6	91	0.619	0.582
0.645	0.2	2/5				
Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
140/	10000	7.83G	1.811	0.8425	0.8836	100
640: 1	.00% 4/4	[00:07<00	:00, 1.84s	S/it] Instances	Box(P	R
mAP50	mAP50-9	95): 100%	1/1 [00:00<	<00:00, 3.0	00it/s]	
0 797	0.3	all 376	6	100	0.687	0.407
	m:	icrocrack	6	1	1	0
0.995	0.3	398 porosity	6	8	0.421	0.637
	0.4	457				
	ınmelted 0.∶	particle 273	6	91	0.64	0.582
			hov loss	olo loco	dfl loss	Tretores
Size	•	_	_	_	dfl_loss	
			1.635 9:00, 1.949		0.8757	88
040: 1		Class	Images	Instances	Box(P	R
mAP50	mAP50-9	95): 100% all	1/1 [00:00<6	<00:00, 4.5 100	58it/s] 0.449	0.728
0.767		329				
0.995		icrocrack 298	6	1	0.382	1
		porosity	6	8	0.365	0.625
0.667		398 particle	6	91	0.601	0.56
0.639		.29		31	01001	0.30
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size	10000	- 7.83G	1.75	0.8046	0.8725	78
		[00:08<00	0:00, 2.175			
		Class	Images	Instances	Box(P	R

mAP50 mA		100% all	1/1 [00:00<		33it/s] 0.696	0.439
0.531	0.256					
0.249	micro 0.0498	crack	6	1	1	0
0.618	por	osity	6	8	0.394	0.625
	elted par	ticle	6	91	0.694	0.692
						_
Epo Size	och GPI	U_mem	box_loss	cls_loss	dfl_loss	Instances
			1.741 0:00, 1.78s		0.8647	61
		Class		Instances	Box(P	R
					0.777	0.339
0.438	0.196 micro	crack	6	1	1	0
0.0622				8	0.679	0.5
0.616	0.299	_				
unme 0.635	lted par 0.273	ticle	6	91	0.653	0.516
	ch GPI	U_mem	box_loss	cls_loss	dfl_loss	Instances
Size 144/100	000	7.83G	1.677	0.7966	0.8655	77
640: 100%	4/4 [00	:08<00):00, 2.22s	s/it]		
mAP50 mA	P50-95):	100%	1/1 [00:00<		Box(P Blit/s]	
0.74	0 312	all	6	100	0.559	0.673
	micro		6	1	0.328	1
0.995	0.348 por	osity	6	8	0.664	0.375
0.535	0.301 elted par	ticle	6	91	0.685	0.645
0.69	0.286	cicce	U	91	0.005	0.045
Epo Size	ch GPI	U_mem	box_loss	cls_loss	dfl_loss	Instances
145/100			1.574 0:00, 2.28s		0.8696	47
		Class	Images	Instances		R
mAP50 mA	(P50-95):	all	1/1 [00:00< 6	<00:00, 4.2 100	0.673	0.636
0.711	0.242 micro	crack	6	1	0.813	1
0.995	0.199	C. ack	0	1	0.013	1

0.464	0.	porosity	6	8	0.571	0.339
		particle	6	0.1	0.633	0.560
	0		O	91	0.033	0.509
Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
146/	10000	7.83G	1.7	0.7547	0.8892	77
		Class		Instances	Box(P	R
mAP50	mAP50-			<00:00, 4.2 100	25it/s] 0.555	0.684
0.725	0.	284		1	0.60	1
0.995		icrocrack 298	6	1	0.69	1
0 5/15	0.	porosity	6	8	0.409	0.436
u	ınmelted	particle	6	91	0.567	0.615
0.635	0.	254				
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 147/	10000	7.83G	1.581	0.7379	0.8728	59
640: 1	.00% 4/4):00, 2.22s		Box(P	R
mAP50	mAP50-			<00:00, 4.0		K
		all	6	100	0.56	0.649
0.723	0. m	icrocrack	6	1	0.501	1
0.995		228 porosity	6	8	0.538	0.298
	0.	248	0	0	0.330	0.290
	nmelted 0.	particle 285	6	91	0.639	0.648
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances
Size 148/	10000	7.83G	1.642	0.7868	0.8792	44
-		[00:08<00	0:00, 2.16	s/it]		
mAP50	mAP50-	Class 95): 100%		Instances 4.4 ,00:00	Box(P 43it/sl	R
		all	6	100		0.59
0.696		.27 icrocrack	6	1	0.843	1
0.995	0.	298 porosity	6	8	0.458	0.25
0.463		257				
0.629		particle 255	6	91	0.673	0.52

	Enach	CDII mom	hov loss	cle loce	dfl loss	Tristances	
Size	•	_	_	_	_		
149/	10000	7.83G	1.583	0.7848	0.8766	60	
040: 1	.00% 4/4	Class	:00, 1.85s Images	Instances	Box (P	R	
mAP50	mAP50-9	95): 100%	1/1 [00:00<	00:00, 4.5	9it/s]		
0.755	0.2	all 231	0	100	0.718	0.015	
0 005	mi 0.09		6	1	0.86	1	
0.995	0.05	porosity	6	8	0.536	0.295	
0.603	0.3	309 particle	6	0.1	0.758	0.551	
0.666	0.2	285	0	91	0.736	0.551	
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	
Size 150/	10000	7.83G	1.758	0.7899	0.8772	39	
640: 1	.00% 4/4	[00:08<00	:00, 2.17s	/it]			
mAP50	mAP50-9	95): 100%	1mages 1/1 [00:00<	:00:00, 4.4	Box(P 4it/s]	R	
	0.2	all	6	100	0.664	0.685	
	mi	icrocrack	6	1	0.821	1	
0.995	0.2	298	6	Q	0.42	0.375	
	0.2	294					
	nmelted 0.2	particle 001	6	91	0.751	0.681	
					167 7		
Size	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	
151/					0.8516	75	
640: 1	640: 100% 4/4 [00:08<00:00, 2.09s/it] Class Images Instances Box(P R						
mAP50	mAP50-9	95): 100% all	1/1 [00:00<	:00:00, 2.7 100	/3it/s]	0.406	
0.447	0.2		6	100	0.426	0.400	
Θ	mi O	icrocrack	6	1	0	0	
		porosity	6	8	0.606	0.581	
0.638	0.3 hetlemou	384 particle	6	91	0.671	0.637	
0.704	0.2		0	91	0.071	0.037	
	Epoch	GPU_mem	box_loss	cls_loss	dfl_loss	Instances	
	10000		1.646	0.7371	0.874	63	
640: 1	.00% 4/4	[00:07<00 Class	:00, 1.91s Images	[/it] Instances	Box (P	R	
			J		,		

```
mAP50
       mAP50-95): 100% 1/1 [00:00<00:00,
                                         4.31it/sl
                                                              0.769
                   all
                                6
                                         100
                                               0.793
0.805
           0.314
            microcrack
                                                    0.84
                                                                  1
                                6
0.995
           0.199
                                6
                                           8
                                                   0.822
                                                              0.625
              porosity
0.692
           0.429
     unmelted particle
                                6
                                          91
                                                  0.717
                                                              0.681
0.729
           0.314
Stopping training early as no improvement observed in last 50 epochs.
Best results observed at epoch 102, best model saved as best.pt.
To update EarlyStopping(patience=50) pass a new patience value, i.e.
`patience=300` or use `patience=0` to disable EarlyStopping.
152 epochs completed in 0.387 hours.
Optimizer stripped from runs/detect/train/weights/last.pt, 22.5MB
Optimizer stripped from runs/detect/train/weights/best.pt, 22.5MB
Validating runs/detect/train/weights/best.pt...
Ultralytics YOLOv8.0.20 ₹ Python-3.10.6 torch-2.0.1+cull8 CUDA:0
(Tesla V100-SXM2-16GB, 16151MiB)
Model summary (fused): 168 layers, 11126745 parameters, 0 gradients,
28.4 GFLOPs
                           Images Instances
                                                                  R
                 Class
                                                  Box (P
mAP50
      mAP50-95): 100% 1/1 [00:00<00:00, 4.68it/s]
                   all
                                6
                                         100
                                                  0.479
                                                              0.821
0.823
           0.474
            microcrack
                                                  0.501
                                                                  1
0.995
           0.597
                                                               0.75
                                6
                                           8
                                                  0.337
              porosity
0.768
           0.508
                                          91
                                                              0.714
     unmelted particle
                                                  0.598
           0.316
0.705
Speed: 0.2ms pre-process, 2.3ms inference, 0.0ms loss, 1.1ms post-
process per image
Results saved to runs/detect/train
!ls
data.yaml
               README.roboflow.txt test
                                            volov8s.pt
README.dataset.txt runs
                                  train
model = YOLO('/content/yolov8-1/runs/detect/train/weights/best.pt')
from ultralytics import YOLO
from PIL import Image
import cv2
# from PIL
ima =
Image.open("/content/yolov8-1/test/images/rsz slm square finalx15k 003
```

```
5_jpg.rf.e5c332015d1f1a4bd24149f60d603f7c.jpg")
results = model.predict(source=img, save=True)

Ultralytics YOLOv8.0.20  Python-3.10.6 torch-2.0.1+cul18 CUDA:0
(Tesla V100-SXM2-16GB, 16151MiB)
Model summary (fused): 168 layers, 11126745 parameters, 0 gradients, 28.4 GFLOPs
Results saved to runs/detect/predict

# print(results)
display(Image.open('/content/yolov8-1/runs/detect/predict/image0.jpg'))
```

```
porosity 0.71
                            unmelted partic
unmelted particle 0.29 unmelted
        unmelted particle 0.67 article 0.3
                   unmelted particle 0.68
                                unmelted po
           unmunmelted particle 0.84:un
unmelted particle 0.69
     unmelted particle 0.83
                                        100µm
15kV 7.0mm L-X1.50k BSE H
```