Data analisys from multi-spectral information

MRobalinho - UPT 27-4-2019

In [1]:

```
# Add libraries
import glob, os
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
import seaborn as sns
```

In [2]:

```
# Clear all
os.system( 'cls' )

# Verify my current folder
currDir = os.path.dirname(os.path.realpath("__file__"))
mypath = currDir
print(currDir)
```

```
C:\Users\manuel.robalinho\Google Drive\UPT_Portucalense\Trabalho final\Cla
ssificacao_Sucata\Jupyter_Notebook
```

In [3]:

```
# Create path
xfile  = 'upt_data.xlsx'  # Excel file
xsheet = 'imagedata06'   # Excel Sheet

arq_xls = mypath + '/'+xfile
```

In [4]:

```
# Read Excel file
df = pd.read_excel(xfile,sheetname=xsheet,header=0,converters={'Size':str,'Color_RGB':s
tr})
```

```
C:\Users\manuel.robalinho\AppData\Local\Continuum\anaconda3\lib\site-packa
ges\pandas\io\excel.py:329: FutureWarning: The `sheetname` keyword is depr
ecated, use `sheet_name` instead
  **kwds)
```

In [5]:

```
df
```

Out[5]:

	Folder	File	Material	Size	Format	Mode	All_Bands	Sum_(
0	imagedata06	Aluminum_1.tif	Aluminum	(2048, 1536)	TIFF	RGB	658.137536	220.999
1	imagedata06	Aluminum_2.tif	Aluminum	(2048, 1536)	TIFF	RGB	693.024169	232.705
2	imagedata06	Aluminum_3.tif	Aluminum	(2048, 1536)	TIFF	RGB	696.532319	233.779
3	imagedata06	Aluminum_4.tif	Aluminum	(2048, 1536)	TIFF	RGB	658.137536	220.999
4	imagedata06	Aluminum_5.tif	Aluminum	(2048, 1536)	TIFF	RGB	693.024169	232.705
5	imagedata06	Aluminum_6.tif	Aluminum	(2048, 1536)	TIFF	RGB	696.532319	233.779
6	imagedata06	Brass_1.tif	Brass	(2048, 1536)	TIFF	RGB	562.098115	189.033
7	imagedata06	Brass_2.tif	Brass	(2048, 1536)	TIFF	RGB	449.396523	151.345
8	imagedata06	Brass_3.tif	Brass	(2048, 1536)	TIFF	RGB	469.763357	158.316
9	imagedata06	Brass_4.tif	Brass	(2048, 1536)	TIFF	RGB	562.098115	189.033
10	imagedata06	Brass_5.tif	Brass	(2048, 1536)	TIFF	RGB	449.396523	151.345
11	imagedata06	Brass_6.tif	Brass	(2048, 1536)	TIFF	RGB	469.763357	158.316
12	imagedata06	CopperWire_1.tif	CopperWire	(2048, 1536)	TIFF	RGB	521.051218	175.360
13	imagedata06	CopperWire_2.tif	CopperWire	(2048, 1536)	TIFF	RGB	634.394685	213.195
14	imagedata06	CopperWire_3.tif	CopperWire	(2048, 1536)	TIFF	RGB	481.236521	162.041
15	imagedata06	CopperWire_4.tif	CopperWire	(2048, 1536)	TIFF	RGB	564.848218	189.837
16	imagedata06	CopperWire_5.tif	CopperWire	(2048, 1536)	TIFF	RGB	521.051218	175.360
17	imagedata06	CopperWire_6.tif	CopperWire	(2048, 1536)	TIFF	RGB	634.394685	213.195
18	imagedata06	CopperWire_7.tif	CopperWire	(2048, 1536)	TIFF	RGB	481.236521	162.041
19	imagedata06	CopperWire_8.tif	CopperWire	(2048, 1536)	TIFF	RGB	564.848218	189.837
20	imagedata06	Copper_1.tif	Copper	(2048, 1536)	TIFF	RGB	447.139193	150.632
21	imagedata06	Copper_2.tif	Copper	(2048, 1536)	TIFF	RGB	588.109624	197.635
22	imagedata06	Copper_3.tif	Copper	(2048, 1536)	TIFF	RGB	447.139193	150.632
23	imagedata06	Copper_4.tif	Copper	(2048, 1536)	TIFF	RGB	588.109624	197.635

	Folder	File	Material	Size	Format	Mode	All_Bands	Sum_(
24	imagedata06	Iron_1.tif	Iron	(2048, 1536)	TIFF	RGB	641.517597	215.555
25	imagedata06	Iron_2.tif	Iron	(2048, 1536)	TIFF	RGB	641.517597	215.555
26	imagedata06	Iron_3.tif	Iron	(2048, 1536)	TIFF	RGB	601.674947	202.340
27	imagedata06	Iron_4.tif	Iron	(2048, 1536)	TIFF	RGB	575.482113	193.527
28	imagedata06	PaintedIron_1.tif	PaintedIron	(2048, 1536)	TIFF	RGB	495.478663	166.811
29	imagedata06	PaintedIron_2.tif	PaintedIron	(2048, 1536)	TIFF	RGB	606.481866	203.824
30	imagedata06	PaintedIron_3.tif	PaintedIron	(2048, 1536)	TIFF	RGB	573.568470	192.841
31	imagedata06	PaintedIron_4.tif	PaintedIron	(2048, 1536)	TIFF	RGB	495.478663	166.811
32	imagedata06	PaintedIron_5.tif	PaintedIron	(2048, 1536)	TIFF	RGB	606.481866	203.824
33	imagedata06	PaintedIron_6.tif	PaintedIron	(2048, 1536)	TIFF	RGB	573.568470	192.841
34	imagedata06	PaintedIron_7.tif	PaintedIron	(2048, 1536)	TIFF	RGB	606.481866	203.824
35	imagedata06	StainlessSteel_1.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	654.906666	219.931
36	imagedata06	StainlessSteel_2.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	573.675257	192.847
37	imagedata06	StainlessSteel_3.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	654.906666	219.931
38	imagedata06	StainlessSteel_4.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	573.675257	192.847
39	imagedata06	StainlessSteel_5.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	638.936045	214.726
40	imagedata06	StainlessSteel_6.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	731.365569	245.627
41	imagedata06	StainlessSteel_7.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	595.649206	200.158
42	imagedata06	StainlessSteel_8.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	611.667734	205.504
43	imagedata06	StainlessSteel_9.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	860.058381	288.366

44 rows × 24 columns

In [6]:

```
# Adjust Material name
df['Material'].replace('alum', 'aluminum',inplace=True)
df['Material'].replace('plasticised', 'plasticised_copper',inplace=True)
df['Material'].replace('stainless', 'stainless_steel',inplace=True)
df['Material'].replace('painted', 'painted_iron',inplace=True)
df
```

Out[6]:

	Folder	File	Material	Size	Format	Mode	All_Bands	Sum_(
0	imagedata06	Aluminum_1.tif	Aluminum	(2048, 1536)	TIFF	RGB	658.137536	220.999
1	imagedata06	Aluminum_2.tif	Aluminum	(2048, 1536)	TIFF	RGB	693.024169	232.705
2	imagedata06	Aluminum_3.tif	Aluminum	(2048, 1536)	TIFF	RGB	696.532319	233.779
3	imagedata06	Aluminum_4.tif	Aluminum	(2048, 1536)	TIFF	RGB	658.137536	220.999
4	imagedata06	Aluminum_5.tif	Aluminum	(2048, 1536)	TIFF	RGB	693.024169	232.705
5	imagedata06	Aluminum_6.tif	Aluminum	(2048, 1536)	TIFF	RGB	696.532319	233.779
6	imagedata06	Brass_1.tif	Brass	(2048, 1536)	TIFF	RGB	562.098115	189.033
7	imagedata06	Brass_2.tif	Brass	(2048, 1536)	TIFF	RGB	449.396523	151.345
8	imagedata06	Brass_3.tif	Brass	(2048, 1536)	TIFF	RGB	469.763357	158.316
9	imagedata06	Brass_4.tif	Brass	(2048, 1536)	TIFF	RGB	562.098115	189.033
10	imagedata06	Brass_5.tif	Brass	(2048, 1536)	TIFF	RGB	449.396523	151.345
11	imagedata06	Brass_6.tif	Brass	(2048, 1536)	TIFF	RGB	469.763357	158.316
12	imagedata06	CopperWire_1.tif	CopperWire	(2048, 1536)	TIFF	RGB	521.051218	175.360
13	imagedata06	CopperWire_2.tif	CopperWire	(2048, 1536)	TIFF	RGB	634.394685	213.195
14	imagedata06	CopperWire_3.tif	CopperWire	(2048, 1536)	TIFF	RGB	481.236521	162.041
15	imagedata06	CopperWire_4.tif	CopperWire	(2048, 1536)	TIFF	RGB	564.848218	189.837
16	imagedata06	CopperWire_5.tif	CopperWire	(2048, 1536)	TIFF	RGB	521.051218	175.360
17	imagedata06	CopperWire_6.tif	CopperWire	(2048, 1536)	TIFF	RGB	634.394685	213.195
18	imagedata06	CopperWire_7.tif	CopperWire	(2048, 1536)	TIFF	RGB	481.236521	162.041
19	imagedata06	CopperWire_8.tif	CopperWire	(2048, 1536)	TIFF	RGB	564.848218	189.837
20	imagedata06	Copper_1.tif	Copper	(2048, 1536)	TIFF	RGB	447.139193	150.632
21	imagedata06	Copper_2.tif	Copper	(2048, 1536)	TIFF	RGB	588.109624	197.635
22	imagedata06	Copper_3.tif	Copper	(2048, 1536)	TIFF	RGB	447.139193	150.632
23	imagedata06	Copper_4.tif	Copper	(2048, 1536)	TIFF	RGB	588.109624	197.635

	Folder	File	Material	Size	Format	Mode	All_Bands	Sum_(
24	imagedata06	Iron_1.tif	Iron	(2048, 1536)	TIFF	RGB	641.517597	215.555
25	imagedata06	Iron_2.tif	Iron	(2048, 1536)	TIFF	RGB	641.517597	215.555
26	imagedata06	Iron_3.tif	Iron	(2048, 1536)	TIFF	RGB	601.674947	202.340
27	imagedata06	Iron_4.tif	Iron	(2048, 1536)	TIFF	RGB	575.482113	193.527
28	imagedata06	PaintedIron_1.tif	PaintedIron	(2048, 1536)	TIFF	RGB	495.478663	166.811
29	imagedata06	PaintedIron_2.tif	PaintedIron	(2048, 1536)	TIFF	RGB	606.481866	203.824
30	imagedata06	PaintedIron_3.tif	PaintedIron	(2048, 1536)	TIFF	RGB	573.568470	192.841
31	imagedata06	PaintedIron_4.tif	PaintedIron	(2048, 1536)	TIFF	RGB	495.478663	166.811
32	imagedata06	PaintedIron_5.tif	PaintedIron	(2048, 1536)	TIFF	RGB	606.481866	203.824
33	imagedata06	PaintedIron_6.tif	PaintedIron	(2048, 1536)	TIFF	RGB	573.568470	192.841
34	imagedata06	PaintedIron_7.tif	PaintedIron	(2048, 1536)	TIFF	RGB	606.481866	203.824
35	imagedata06	StainlessSteel_1.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	654.906666	219.931
36	imagedata06	StainlessSteel_2.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	573.675257	192.847
37	imagedata06	StainlessSteel_3.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	654.906666	219.931
38	imagedata06	StainlessSteel_4.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	573.675257	192.847
39	imagedata06	StainlessSteel_5.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	638.936045	214.726
40	imagedata06	StainlessSteel_6.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	731.365569	245.627
41	imagedata06	StainlessSteel_7.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	595.649206	200.158
42	imagedata06	StainlessSteel_8.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	611.667734	205.504
43	imagedata06	StainlessSteel_9.tif	StainlessSteel	(2048, 1536)	TIFF	RGB	860.058381	288.366

44 rows × 24 columns

In [7]:

```
df_plot = df.copy
```

In [60]:

```
# Create pivot table
df_plotx = df.groupby('File')['All_Bands', 'Sum_Ch0','Sum_Ch1','Sum_Ch2','Color_dec',
                                        'Med_Extrems', 'Max_Histog', 'Idx_Max_Histog','M
in_Histog',
                                        'Idx_Min_Histog','perc_R','perc_G','perc_B'].mea
n()
df_plotx
```

Out[60]:

File	All_Bands	Sum_Ch0	Sum_Ch1	Sum_Ch2	Color_dec	Med_Extrems
Aluminum_1.tif	658.137536	220.999978	220.999978	216.137580	16777215	127.833333
Aluminum_2.tif	693.024169	232.705276	232.705276	227.613617	16777215	127.833333
Aluminum_3.tif	696.532319	233.779842	233.779842	228.972635	16777215	127.833333
Aluminum_4.tif	658.137536	220.999978	220.999978	216.137580	16777215	127.833333
Aluminum_5.tif	693.024169	232.705276	232.705276	227.613617	16777215	127.833333
Aluminum_6.tif	696.532319	233.779842	233.779842	228.972635	16777215	127.833333
Brass_1.tif	562.098115	189.033946	189.033946	184.030223	16777215	127.833333
Brass_2.tif	449.396523	151.345791	151.345791	146.704941	16777215	127.833333
Brass_3.tif	469.763357	158.316124	158.316124	153.131109	16777215	127.833333
Brass_4.tif	562.098115	189.033946	189.033946	184.030223	16777215	127.833333
Brass_5.tif	449.396523	151.345791	151.345791	146.704941	16777215	127.833333
Brass_6.tif	469.763357	158.316124	158.316124	153.131109	16777215	127.833333
CopperWire_1.tif	521.051218	175.360057	175.360057	170.331104	16777215	127.833333
CopperWire_2.tif	634.394685	213.195874	213.195874	208.002937	16777215	127.833333
CopperWire_3.tif	481.236521	162.041057	162.041057	157.154407	16777215	127.833333
CopperWire_4.tif	564.848218	189.837464	189.837464	185.173290	16777215	127.833333
CopperWire_5.tif	521.051218	175.360057	175.360057	170.331104	16777215	127.833333
CopperWire_6.tif	634.394685	213.195874	213.195874	208.002937	16777215	127.833333
CopperWire_7.tif	481.236521	162.041057	162.041057	157.154407	16777215	127.833333
CopperWire_8.tif	564.848218	189.837464	189.837464	185.173290	16777215	127.833333
Copper_1.tif	447.139193	150.632053	150.632053	145.875087	16777215	127.833333
Copper_2.tif	588.109624	197.635200	197.635200	192.839224	16777215	127.833333
Copper_3.tif	447.139193	150.632053	150.632053	145.875087	16777215	127.833333
Copper_4.tif	588.109624	197.635200	197.635200	192.839224	16777215	127.833333
Iron_1.tif	641.517597	215.555740	215.555740	210.406117	16777215	127.833333
Iron_2.tif	641.517597	215.555740	215.555740	210.406117	16777215	127.833333
Iron_3.tif	601.674947	202.340947	202.340947	196.993053	16777215	127.833333
Iron_4.tif	575.482113	193.527250	193.527250	188.427613	16777215	127.833333
PaintedIron_1.tif	495.478663	166.811124	166.811124	161.856415	16777215	127.833333
PaintedIron_2.tif	606.481866	203.824174	203.824174	198.833518	16777215	127.833333
PaintedIron_3.tif	573.568470	192.841021	192.841021	187.886428	16777215	127.833333
PaintedIron_4.tif	495.478663	166.811124	166.811124	161.856415	16777215	127.833333
PaintedIron_5.tif	606.481866	203.824174	203.824174	198.833518	16777215	127.833333
PaintedIron_6.tif	573.568470	192.841021	192.841021	187.886428	16777215	127.833333
PaintedIron_7.tif	606.481866	203.824174	203.824174	198.833518	16777215	127.833333
StainlessSteel_1.tif	654.906666	219.931246	219.931246	215.044174	16777215	127.833333

File	All_Bands	Sum_Ch0	Sum_Ch1	Sum_Ch2	Color_dec	Med_Extrems
StainlessSteel_2.tif	573.675257	192.847695	192.847695	187.979867	16777215	127.833333
StainlessSteel_3.tif	654.906666	219.931246	219.931246	215.044174	16777215	127.833333
StainlessSteel_4.tif	573.675257	192.847695	192.847695	187.979867	16777215	127.833333
StainlessSteel_5.tif	638.936045	214.726624	214.726624	209.482797	16777215	127.833333
StainlessSteel_6.tif	731.365569	245.627645	245.627645	240.110279	16777215	127.833333
StainlessSteel_7.tif	595.649206	200.158029	200.158029	195.333148	16777215	127.833333
StainlessSteel_8.tif	611.667734	205.504045	205.504045	200.659644	16777215	127.833333
StainlessSteel_9.tif	860.058381	288.366525	288.366525	283.325331	16777215	127.833333

In [61]:

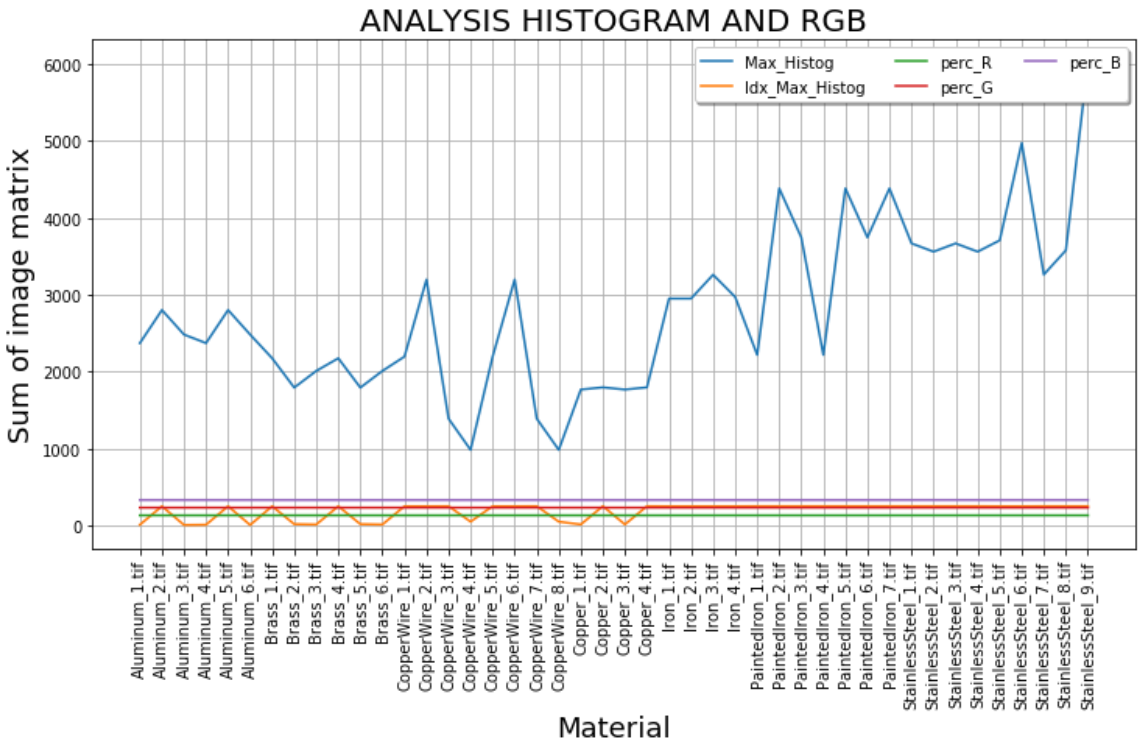
```
# Adjust values to better plot
df_plotx.Sum_Ch0        = df_plotx.Sum_Ch0 + 100 # to have diference lines during plot
df_plotx.Sum_Ch1        = df_plotx.Sum_Ch1 + 500
df_plotx.Sum_Ch2        = df_plotx.Sum_Ch2 + 1000
df_plotx.Color_dec      = df_plotx.Color_dec / 10000
#df_plotx.Color_dec      = df_plotx.Color_dec - 5000
#df_plotx.Med_Extrems    = df_plotx.Med_Extrems * 10
df_plotx.Max_Histog     = df_plotx.Max_Histog
#df_plotx.Idx_Max_Histog = df_plotx.Idx_Max_Histog + 1000
df_plotx.Min_Histog     = df_plotx.Min_Histog
df_plotx.Idx_Min_Histog = df_plotx.Idx_Min_Histog * 10 + 100

df_plotx.perc_R = df_plotx.perc_R + 100
df_plotx.perc_G = df_plotx.perc_G + 200
df_plotx.perc_B = df_plotx.perc_B + 300

#df_plotx
```

In [62]:

```
# Adjust values to better plot
df_plotx.Max_Histog     = df_plotx.Max_Histog / 100
#df_plotx.Idx_Max_Histog = df_plotx.Idx_Max_Histog + 1000
#df_plotx
```

In [63]:

```
df_plotx.plot(y=["Max_Histog","Idx_Max_Histog","perc_R", "perc_G","perc_B"],
figsize=(12,6), grid=True )
# Obtain legend (xticks) for X axis
loc_Array_sum = np.arange(len(df_plotx.index))
# Position of X labels
xtick_loc = list(loc_Array_sum)
# Name of x labels
xticks = list(df_plotx.index)
#-------
#plt.plot(df_plot.Array_sum)
plt.title('ANALYSIS HISTOGRAM AND RGB',fontsize=20)
plt.ylabel('Sum of image matrix',fontsize=18)
plt.xticks(xtick_loc, df_plotx.index, rotation=90)
plt.xlabel('Material',fontsize=18)
plt.legend(loc='upper right', ncol=3, fancybox=True, shadow=True)
plt.savefig(xsheet+"_All Material Histogram and RGB.png")
plt.show()
```



In [64]:

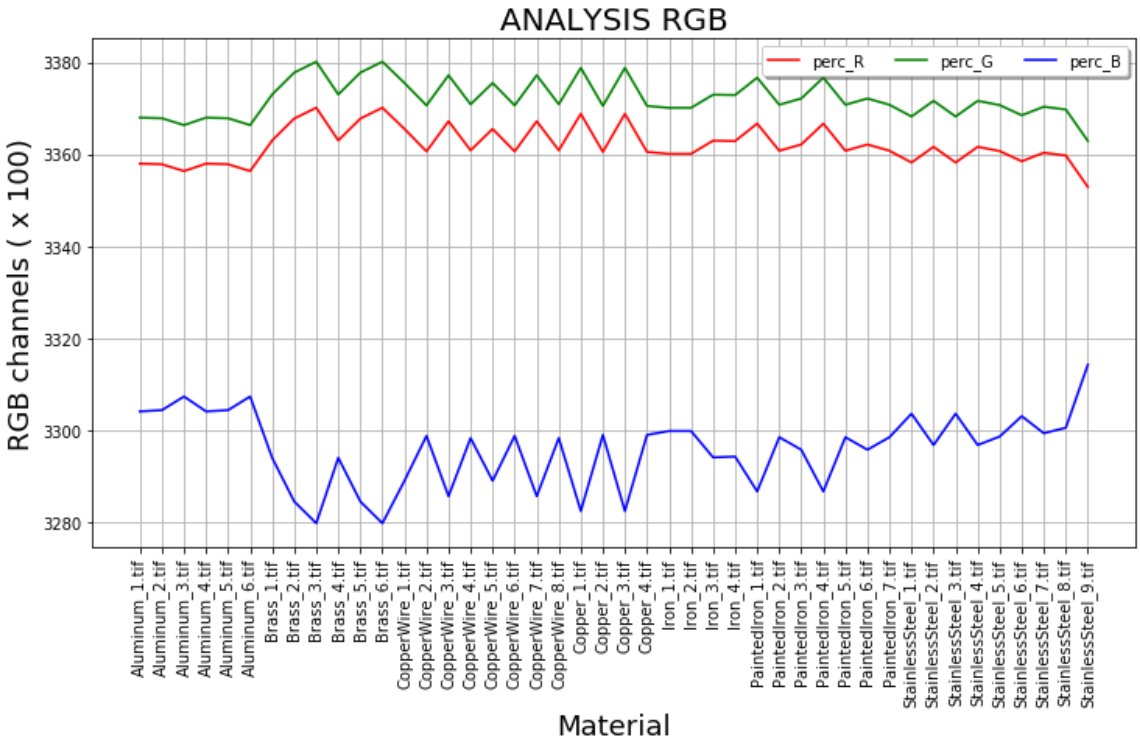
```
# Create pivot table
df_plotx = df.groupby('File')['All_Bands', 'Sum_Ch0','Sum_Ch1','Sum_Ch2','Color_dec',
                                        'Med_Extrems', 'Max_Histog', 'Idx_Max_Histog','M
in_Histog',
                                        'Idx_Min_Histog','perc_R','perc_G','perc_B'].mea
n()
#df_plotx
```

In [65]:

```
# Adjust values to better plot
df_plotx.perc_R     = df_plotx.perc_R * 100
df_plotx.perc_G     = df_plotx.perc_G * 100 + 10
df_plotx.perc_B     = df_plotx.perc_B * 100 + 20
```

In [66]:

```
df_plotx.plot(y=["perc_R", "perc_G","perc_B"],
figsize=(12,6), grid=True, color=('r','g','b') )
# Obtain legend (xticks) for X axis
loc_Array_sum = np.arange(len(df_plotx.index))
# Position of X labels
xtick_loc = list(loc_Array_sum)
# Name of x labels
xticks = list(df_plotx.index)
#-------
#plt.plot(df_plot.Array_sum)
plt.title('ANALYSIS RGB',fontsize=20)
plt.ylabel('RGB channels ( x 100)',fontsize=18)
plt.xticks(xtick_loc, df_plotx.index, rotation=90)
plt.xlabel('Material',fontsize=18)
plt.legend(loc='upper right', ncol=3, fancybox=True, shadow=True)
plt.savefig(xsheet+"_All material Analisys RGB.png")
plt.show()
```



In [67]:

```
# Create pivot table
df_plotx = df.groupby('File')['All_Bands', 'Sum_Ch0','Sum_Ch1','Sum_Ch2','Color_dec',
                                    'Med_Extrems', 'Max_Histog', 'Idx_Max_Histog','M
in_Histog',
                                    'Idx_Min_Histog','perc_R','perc_G','perc_B'].mea
n()
#df_plotx
```

In [68]:

```
# Adjust values to better plot
df_plotx.Sum_Ch0        = df_plotx.Sum_Ch0 + 100 # to have diference lines during plot
df_plotx.Sum_Ch1        = df_plotx.Sum_Ch1 + 500
df_plotx.Sum_Ch2        = df_plotx.Sum_Ch2 + 1000
df_plotx.Color_dec      = df_plotx.Color_dec / 10000
#df_plotx.Color_dec      = df_plotx.Color_dec - 5000
df_plotx.Med_Extrems    = df_plotx.Med_Extrems * 10
df_plotx.Max_Histog     = df_plotx.Max_Histog
df_plotx.Idx_Max_Histog = df_plotx.Idx_Max_Histog + 1000
df_plotx.Min_Histog     = df_plotx.Min_Histog
df_plotx.Idx_Min_Histog = df_plotx.Idx_Min_Histog * 10

df_plotx.perc_R = df_plotx.perc_R + 1000
df_plotx.perc_G = df_plotx.perc_G + 1250
df_plotx.perc_B = df_plotx.perc_B + 1500

#df_plotx
```

In [69]:

```
df_plotx.plot(y=["All_Bands","Sum_Ch0","Sum_Ch1", "Sum_Ch2","Color_dec","Med_Extrems"],
figsize=(12,6), grid=True )
# Obtain legend (xticks) for X axis
loc_Array_sum = np.arange(len(df_plotx.index))
# Position of X labels
xtick_loc = list(loc_Array_sum)
# Name of x labels
xticks = list(df_plotx.index)
#-------
#plt.plot(df_plot.Array_sum)
plt.title('IMAGE WITH ALL CHANNELS',fontsize=20)
plt.ylabel('Sum of image matrix',fontsize=18)
plt.xticks(xtick_loc, df_plotx.index, rotation=90)
plt.xlabel('Material',fontsize=18)
plt.legend(loc='upper right', ncol=3, fancybox=True, shadow=True)
plt.savefig(xsheet+"_All material Line Graph all channels information.png")
plt.show()
```

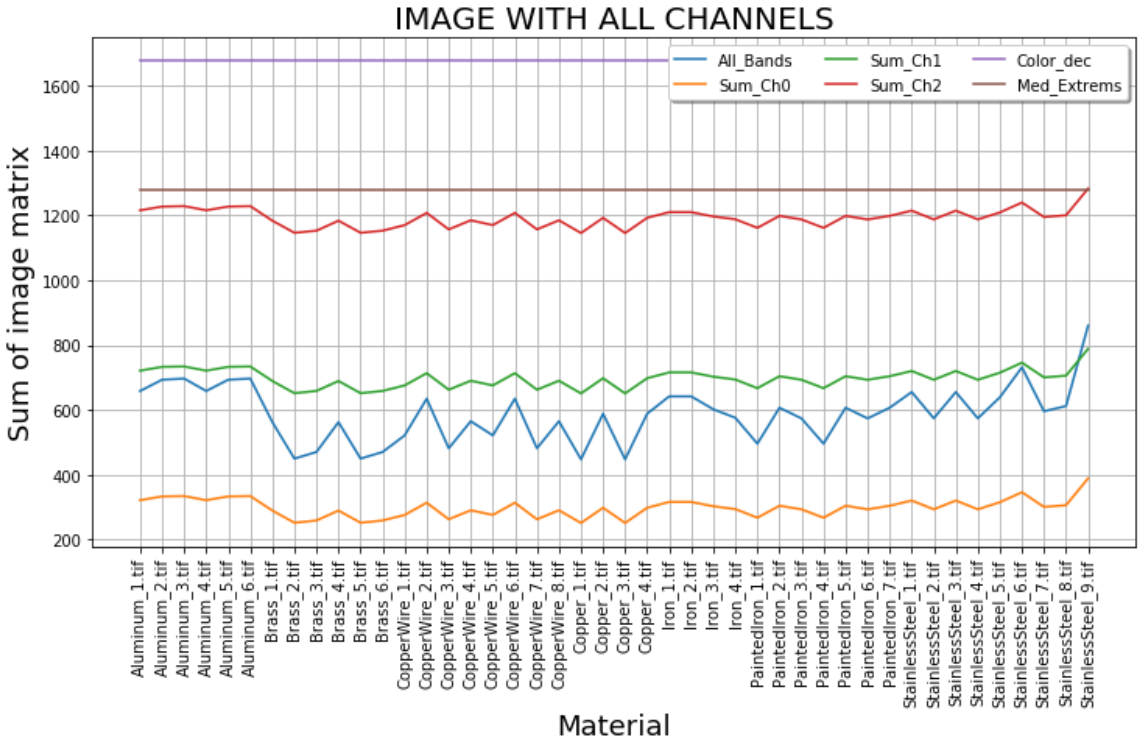


IMAGE WITH ALL CHANNELS
All_Bands
Sum_Ch0
Sum_Ch1
Sum_Ch2
Color_dec
Med_Extrems
Sum of image matrix
1600
1400
1200
1000
800
600
400
200
Aluminum_1.tif
Aluminum_2.tif
Aluminum_3.tif
Aluminum_4.tif
Aluminum_5.tif
Aluminum_6.tif
Brass_1.tif
Brass_2.tif
Brass_3.tif
Brass_4.tif
Brass_5.tif
Brass_6.tif
CopperWire_1.tif
CopperWire_2.tif
CopperWire_3.tif
CopperWire_4.tif
CopperWire_5.tif
CopperWire_6.tif
CopperWire_7.tif
CopperWire_8.tif
Copper_1.tif
Copper_2.tif
Copper_3.tif
Copper_4.tif
Iron_1.tif
Iron_2.tif
Iron_3.tif
Iron_4.tif
PaintedIron_1.tif
PaintedIron_2.tif
PaintedIron_3.tif
PaintedIron_4.tif
PaintedIron_5.tif
PaintedIron_6.tif
PaintedIron_7.tif
StainlessSteel_1.tif
StainlessSteel_2.tif
StainlessSteel_3.tif
StainlessSteel_4.tif
StainlessSteel_5.tif
StainlessSteel_6.tif
StainlessSteel_7.tif
StainlessSteel_8.tif
StainlessSteel_9.tif
Material

In [70]:

```
'''
# Adjust values to better plot
df_plot.Sum_Ch0        = df_plot.Sum_Ch0 + 100 # to have diference lines during plot
df_plot.Sum_Ch1        = df_plot.Sum_Ch1 + 500
df_plot.Sum_Ch2        = df_plot.Sum_Ch2 + 1000
df_plot.Color_dec      = df_plot.Color_dec / 1000
df_plot.Color_dec      = df_plot.Color_dec - 5000
df_plot.Med_Extrems    = df_plot.Med_Extrems * 10
df_plot.Max_Histog     = df_plot.Max_Histog / 1000
df_plot.Idx_Max_Histog = df_plot.Idx_Max_Histog + 1000
df_plot.Min_Histog     = df_plot.Min_Histog * 100
df_plot.Idx_Min_Histog = df_plot.Idx_Min_Histog * 10

df_plot.perc_R = df_plot.perc_R + 1000
df_plot.perc_G = df_plot.perc_G + 1100
df_plot.perc_B = df_plot.perc_B + 1200

df_plot
'''
```

Out[70]:

```
'\n# Adjust values to better plot\ndf_plot.Sum_Ch0        = df_plot.Sum_Ch
0 + 100 # to have diference lines during plot\ndf_plot.Sum_Ch1        = df
_plot.Sum_Ch1 + 500\ndf_plot.Sum_Ch2        = df_plot.Sum_Ch2 + 1000\ndf_p
lot.Color_dec      = df_plot.Color_dec / 1000\ndf_plot.Color_dec      = df
_plot.Color_dec - 5000\ndf_plot.Med_Extrems    = df_plot.Med_Extrems * 10
\ndf_plot.Max_Histog     = df_plot.Max_Histog / 1000\ndf_plot.Idx_Max_Hist
og = df_plot.Idx_Max_Histog + 1000\ndf_plot.Min_Histog     = df_plot.Min_H
istog * 100\ndf_plot.Idx_Min_Histog = df_plot.Idx_Min_Histog * 10\n\ndf_pl
ot.perc_R = df_plot.perc_R + 1000\ndf_plot.perc_G = df_plot.perc_G + 1100
\ndf_plot.perc_B = df_plot.perc_B + 1200\n\ndf_plot\n'
```

In [71]:

```
# Create pivot table
df_plot1 = df.groupby('Material')['All_Bands', 'Sum_Ch0','Sum_Ch1','Sum_Ch2','Color_de
c',
                                  'Med_Extrems', 'Max_Histog', 'Idx_Max_Histog','M
in_Histog',
                                  'Idx_Min_Histog','perc_R','perc_G','perc_B'].mea
n()
df_plot1
```

Out[71]:

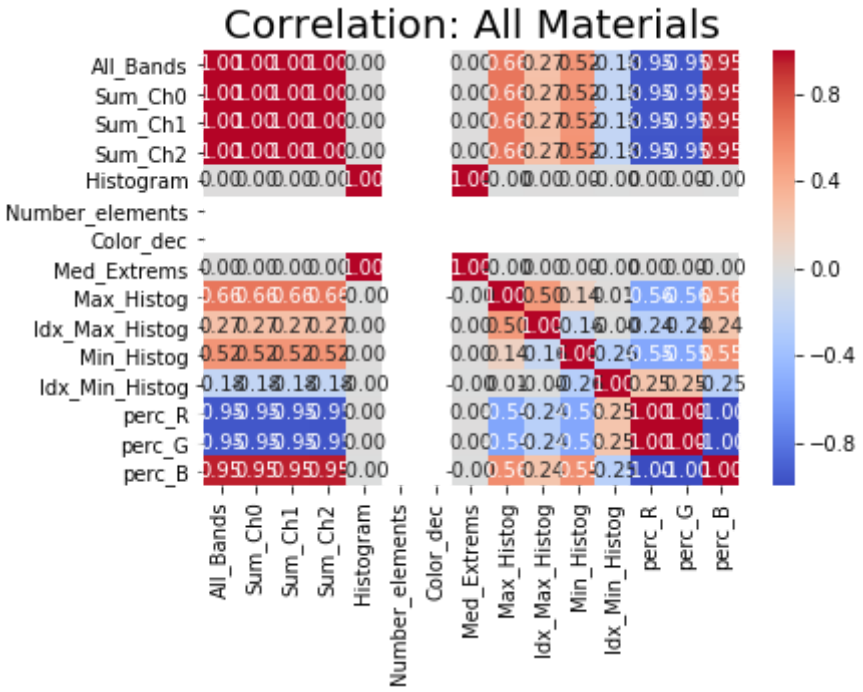
Material	All_Bands	Sum_Ch0	Sum_Ch1	Sum_Ch2	Color_dec	Med_Extrems	
Aluminum	682.564675	229.161699	229.161699	224.241277	16777215.0	127.833333	25
Brass	493.752665	166.231954	166.231954	161.288758	16777215.0	127.833333	19
Copper	517.624409	174.133626	174.133626	169.357156	16777215.0	127.833333	17
CopperWire	550.382660	185.108613	185.108613	180.165435	16777215.0	127.833333	19
Iron	615.048064	206.744919	206.744919	201.558225	16777215.0	127.833333	30
PaintedIron	565.362838	190.110973	190.110973	185.140891	16777215.0	127.833333	35
StainlessSteel	654.982309	219.993417	219.993417	214.995476	16777215.0	127.833333	40

In [72]:

```
# Plot Correlation
def plot_corr(xdf,material,xsheet):
    x,y = 10,5

    fig, ax = plt.subplots()
    sns.heatmap(xdf.corr(method='pearson'), annot=True, fmt='.2f',
                cmap=plt.get_cmap('coolwarm'), cbar=True, ax=ax)

    ax.set_yticklabels(ax.get_yticklabels(), rotation="horizontal")
    plt.title('Correlation: '+material,fontsize=20)
    plt.savefig(xsheet+'_Corr_'+material+'.png', bbox_inches='tight', pad_inches=0.0)
```

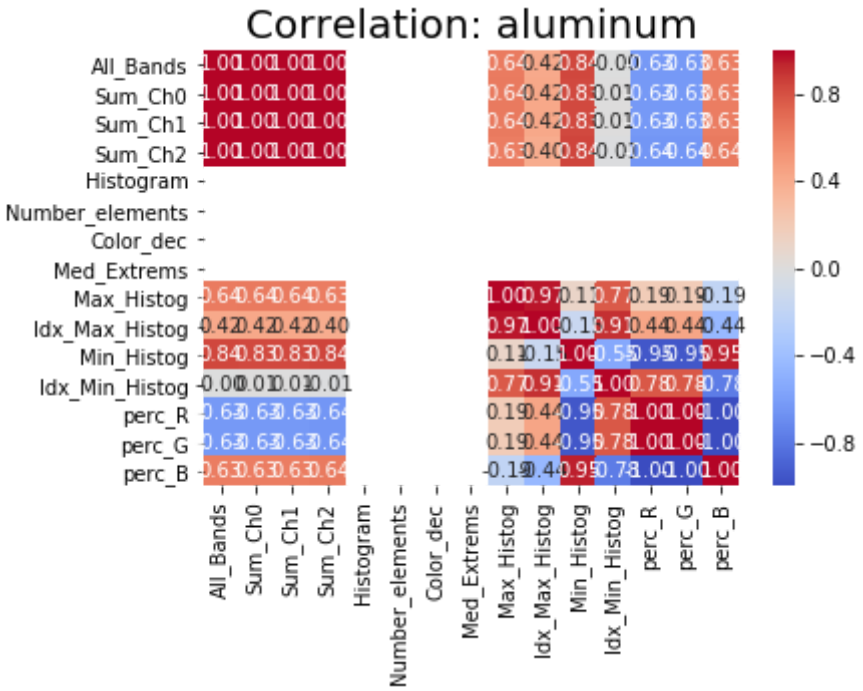
In [73]:

```
material = 'All'
df_x = df

# Plot Correlation
plot_corr(df_x,'All Materials',xsheet)
```



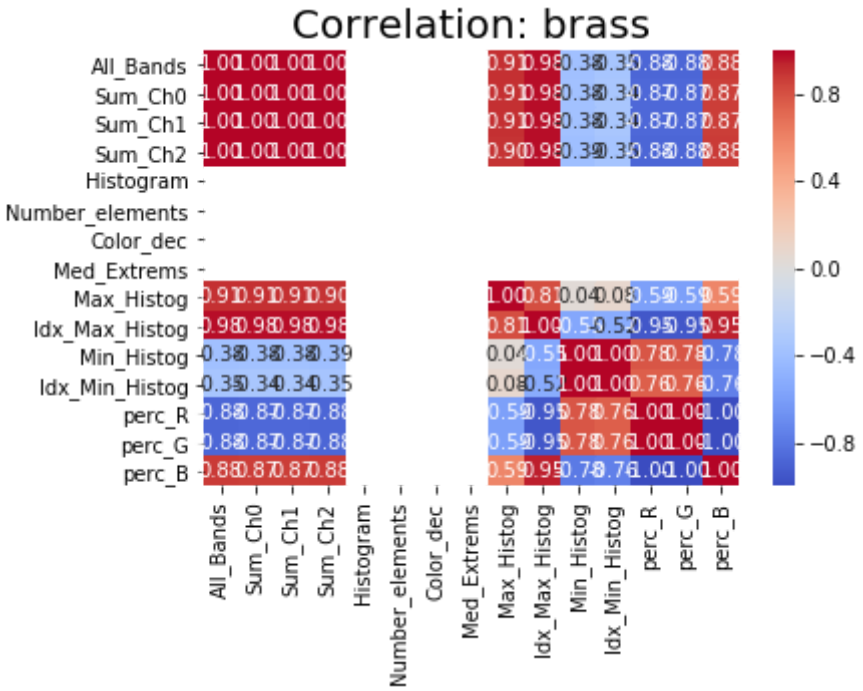
In [74]:

```
material = 'Aluminum'
df_x = df[df['Material']== material]

# Plot Correlation
plot_corr(df_x,'aluminum',xsheet)
```



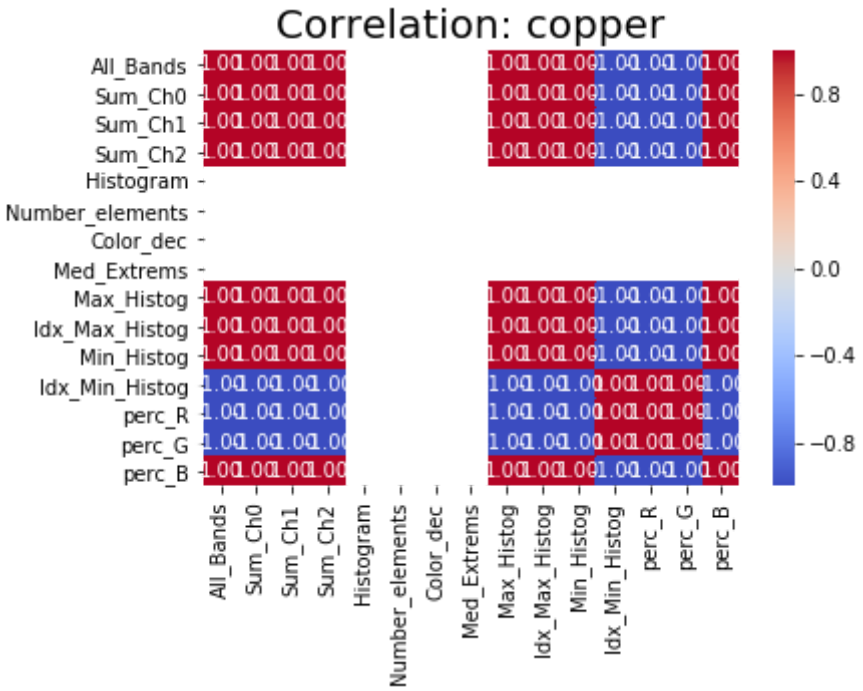
In [75]:

```
material = 'Brass'
df_x = df[df['Material']== material]

# Plot Correlation
plot_corr(df_x,'brass',xsheet)
```



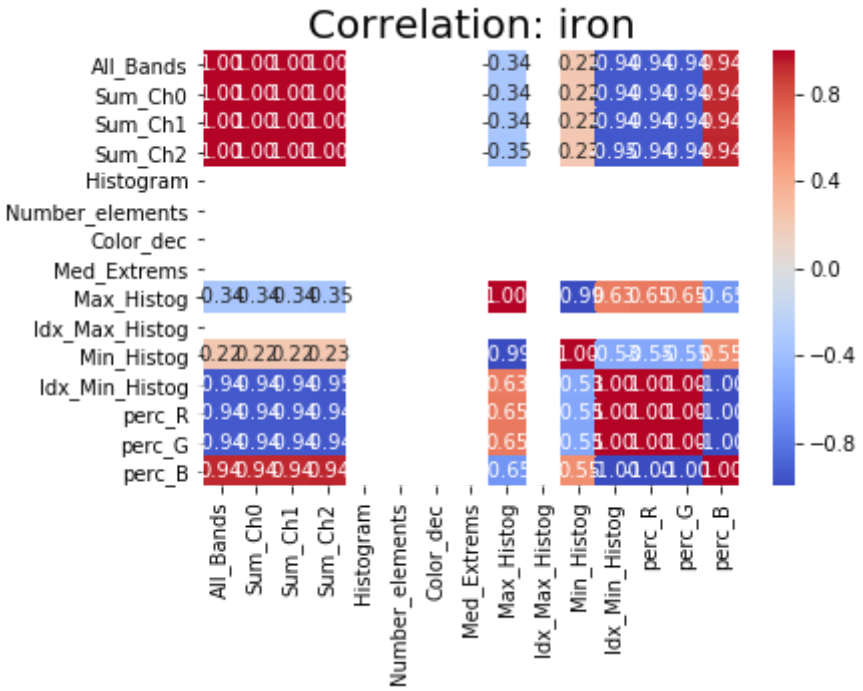
In [76]:

```
material = 'Copper'
df_x = df[df['Material']== material]

# Plot Correlation
plot_corr(df_x,'copper',xsheet)
```



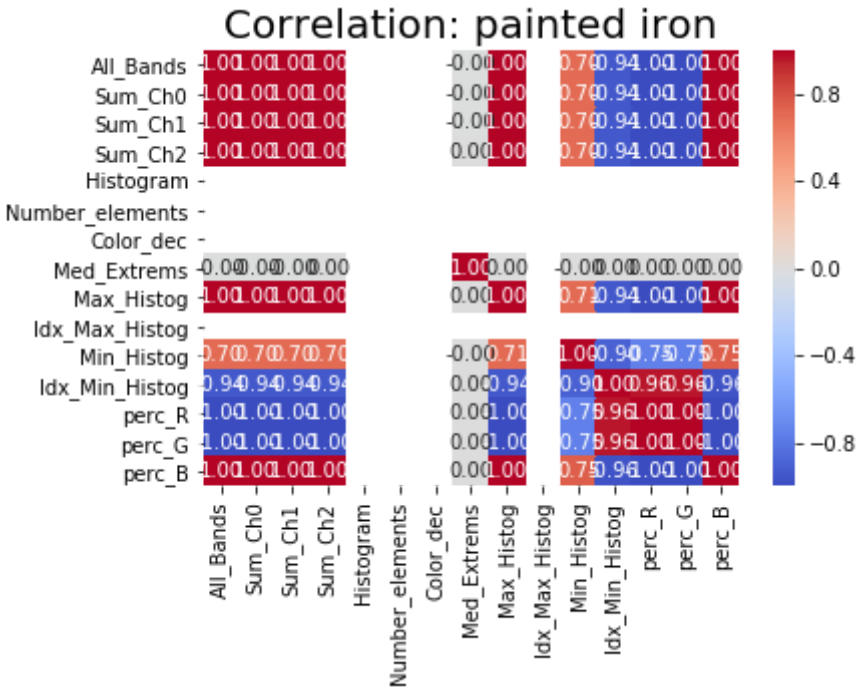
In [77]:

```
material = 'Iron'
df_x = df[df['Material']== material]

# Plot Correlation
plot_corr(df_x,'iron',xsheet)
```



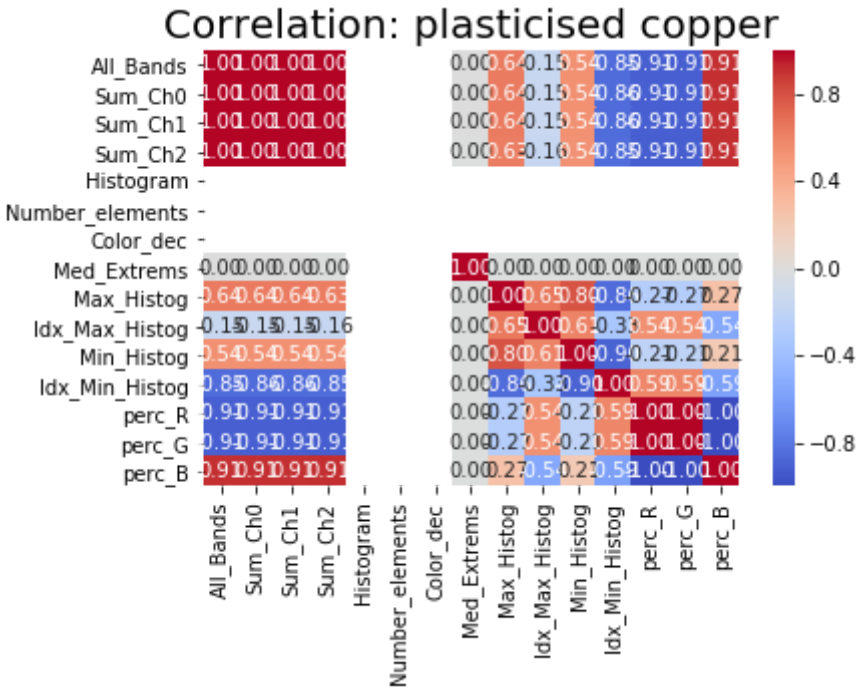
In [78]:

```
material = 'PaintedIron'
df_x = df[df['Material']== material]

# Plot Correlation
plot_corr(df_x,'painted iron',xsheet)
```



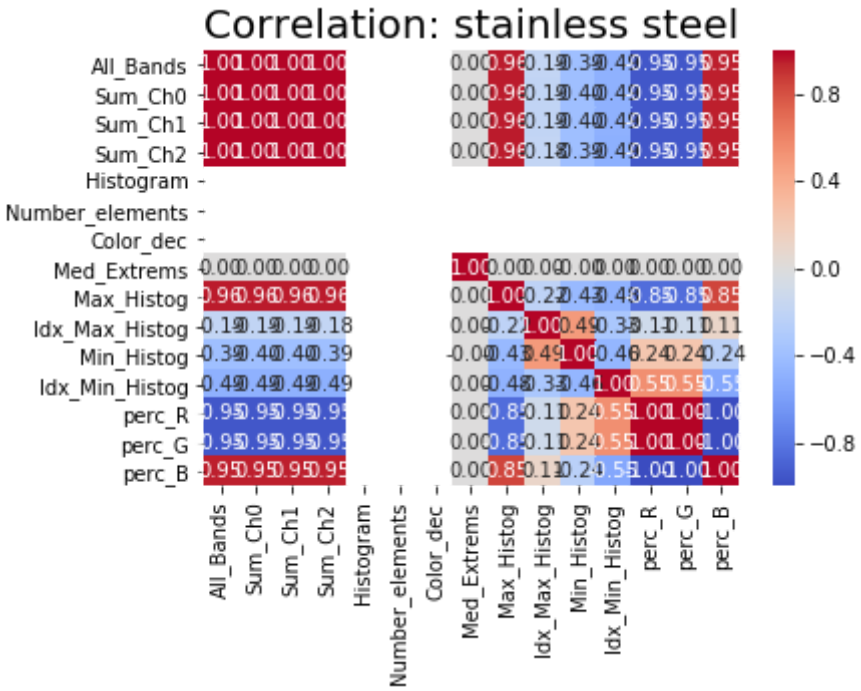
In [79]:

```
material = 'CopperWire'
df_x = df[df['Material']== material]
# Plot Correlation
plot_corr(df_x,'plasticised copper',xsheet)
```



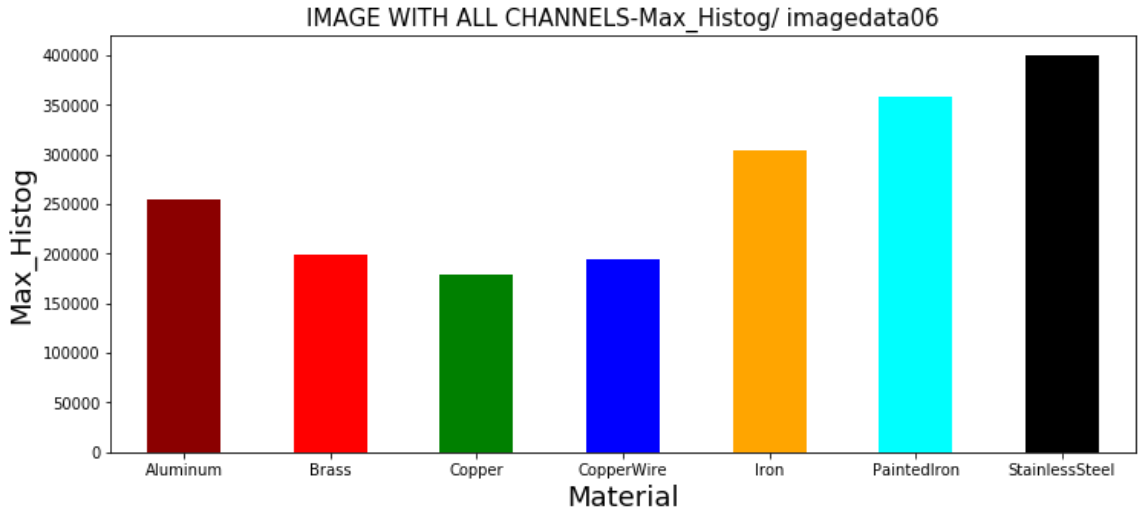
In [80]:

```
material = 'StainlessSteel'
df_x = df[df['Material']== material]

# Plot Correlation
plot_corr(df_x,'stainless steel',xsheet)
```



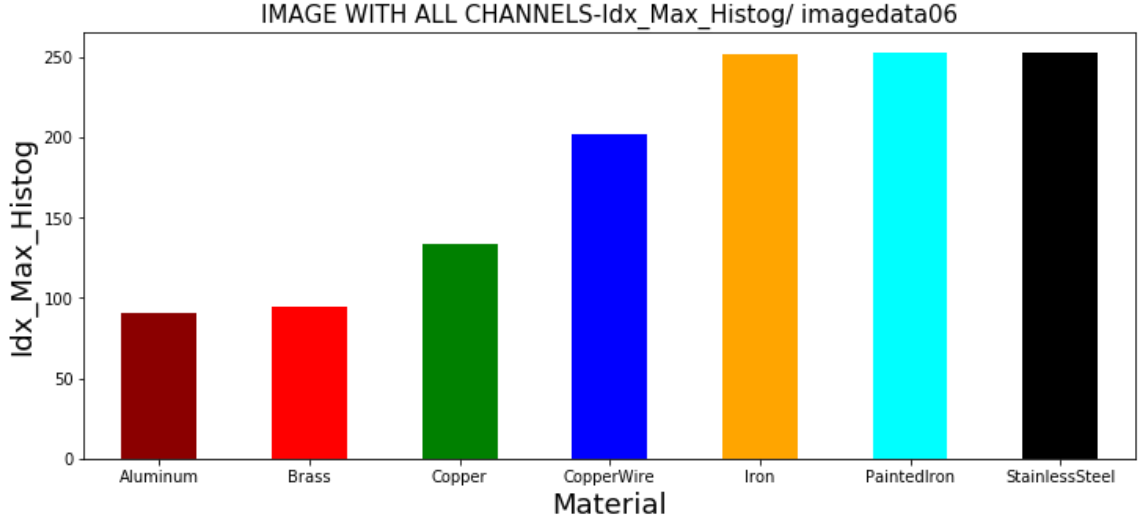
In [81]:

```
df_Max_Histog = pd.DataFrame(df_plot1.Max_Histog)
color = ['darkred','red','green','blue','orange','cyan','black','yellow']

df_Max_Histog.plot(kind='bar', y=0, color=color, legend=False, rot=0, figsize=(12,5))
plt.title('IMAGE WITH ALL CHANNELS-Max_Histog/ '+xsheet,fontsize=15)
plt.xlabel('Material',fontsize=18)
plt.ylabel('Max_Histog',fontsize=18)
plt.savefig(xsheet+'_Max_Histog.png')   # Save  Figure
plt.show()
```



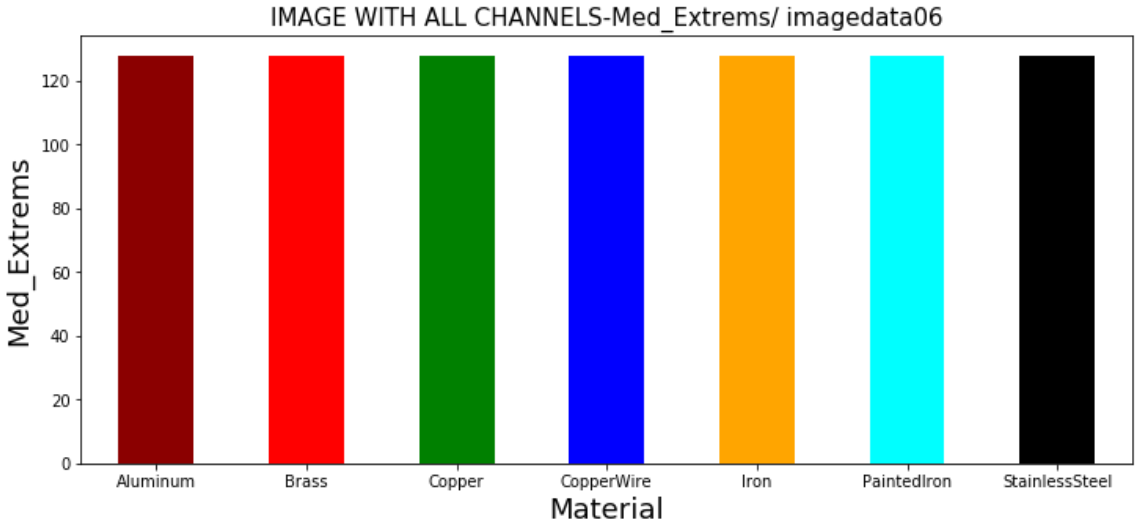
In [82]:

```
df_Idx_Max_Histog = pd.DataFrame(df_plot1.Idx_Max_Histog)
color = ['darkred','red','green','blue','orange','cyan','black','yellow']

df_Idx_Max_Histog.plot(kind='bar', y=0, color=color, legend=False, rot=0, figsize=(12,5
))
plt.title('IMAGE WITH ALL CHANNELS-Idx_Max_Histog/ '+xsheet,fontsize=15)
plt.xlabel('Material',fontsize=18)
plt.ylabel('Idx_Max_Histog',fontsize=18)

plt.savefig(xsheet+'_Idx_Max_Histog.png')   # Save  Figure
plt.show()
```



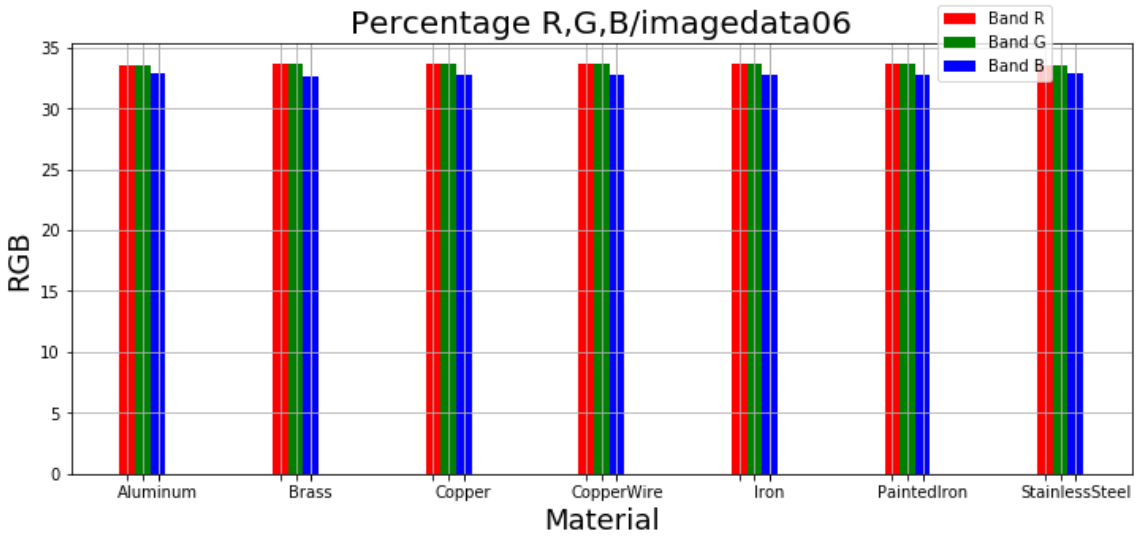
In [83]:

```
df_Med_Extrems = pd.DataFrame(df_plot1.Med_Extrems)
color = ['darkred','red','green','blue','orange','cyan','black','yellow']

df_Med_Extrems.plot(kind='bar', y=0, color=color, legend=False, rot=0, figsize=(12,5))
plt.title('IMAGE WITH ALL CHANNELS-Med_Extrems/ '+xsheet,fontsize=15)
plt.xlabel('Material',fontsize=18)
plt.ylabel('Med_Extrems',fontsize=18)
#plt.legend(loc='upper right', ncol=3, fancybox=True, shadow=True)

plt.savefig(xsheet+'_Med_Extrems.png')   # Save  Figure
plt.show()
```



In [84]:

```
loc_Array_sum = np.arange(len(df_plot1.index))+0.1 # Offsetting the tick-label location

loc_r = np.arange(len(df_plot1.index))-0.1 # Offsetting the tick-label location
loc_g = np.arange(len(df_plot1.index))-0.0 # Offsetting the tick-label location
loc_b = np.arange(len(df_plot1.index))+0.1 # Offsetting the tick-label location

xtick_loc = list(loc_Array_sum) + list(loc_r) + list(loc_g) + list(loc_b)
#xticks = list(selected.keys())+ list(rejected.keys())
xticks = df_plot1.index
colors = ['darkred','red','green','blue','orange','cyan','black','yellow']
plt.figure(figsize=(12,5))

plt.bar(loc_r, df_plot1.perc_R, color='red', width=0.1, label='Band R')
plt.bar(loc_g, df_plot1.perc_G, color='green', width=0.1,label='Band G')
plt.bar(loc_b, df_plot1.perc_B, color='blue', width=0.1,label='Band B')

plt.title('Percentage R,G,B'+'/'+xsheet,fontsize=20)
plt.xlabel('Material',fontsize=18)
plt.ylabel('RGB',fontsize=18)
plt.grid(True)
plt.xticks(xtick_loc, xticks, rotation=0)
plt.legend(bbox_to_anchor=(.8,0.8),\
    bbox_transform=plt.gcf().transFigure)
plt.savefig(xsheet+"_Bar Diagram_perc_RGB.png")
plt.show()
```



In [85]:

```
# Create pivot table
df_plot2 = df.groupby('Material')['Color_dec','Med_Extrems', 'Max_Histog',
                                  'Idx_Max_Histog','Min_Histog','Idx_Min_Histog',
                                   'perc_R', 'perc_G', 'perc_B'].mean()
df_plot2
```

Out[85]:

Material	Color_dec	Med_Extrems	Max_Histog	Idx_Max_Histog	Min_Histog	Idx_Mi
Aluminum	16777215.0	127.833333	255335.333333	90.333333	670.000000	11
Brass	16777215.0	127.833333	199378.000000	95.000000	271.666667	8
Copper	16777215.0	127.833333	178328.000000	134.000000	420.500000	12
CopperWire	16777215.0	127.833333	194312.000000	202.000000	107.250000	23
Iron	16777215.0	127.833333	303478.250000	252.000000	382.500000	12
PaintedIron	16777215.0	127.833333	358354.000000	253.000000	127.428571	13
StainlessSteel	16777215.0	127.833333	400068.444444	252.777778	455.666667	22

In [86]:

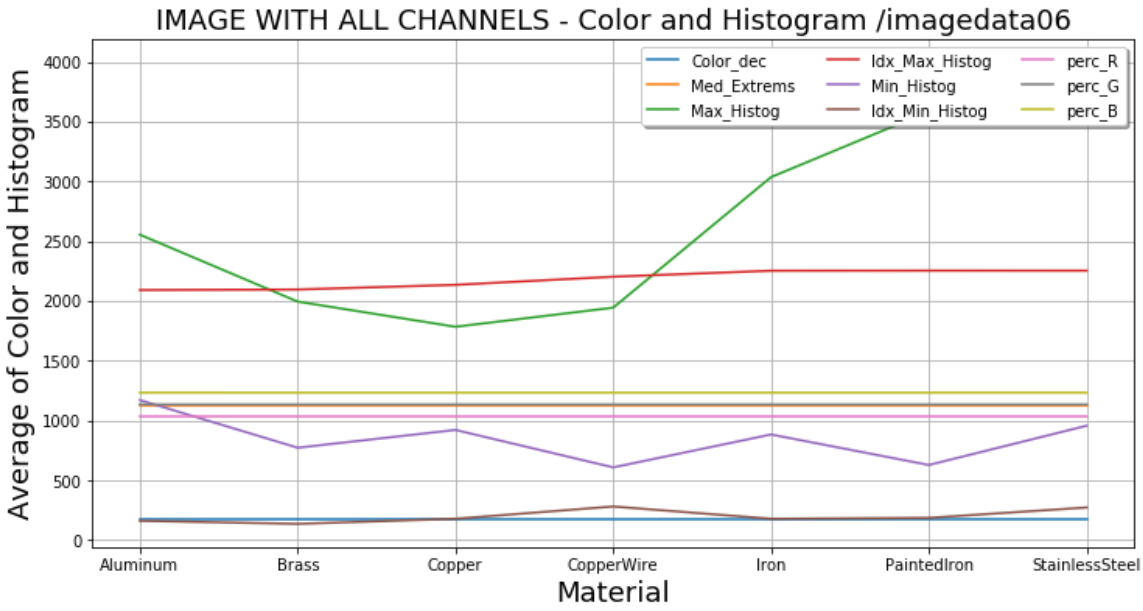
```
# Arranje values
df_plot2.Color_dec      = df_plot2.Color_dec / 100000
df_plot2.Med_Extrems    = df_plot2.Med_Extrems + 1000
df_plot2.Max_Histog     = df_plot2.Max_Histog / 100
df_plot2.Idx_Max_Histog = df_plot2.Idx_Max_Histog + 2000
df_plot2.Min_Histog     = df_plot2.Min_Histog +500
df_plot2.Idx_Min_Histog = df_plot2.Idx_Min_Histog + 50

df_plot2.perc_R = df_plot2.perc_R + 1000
df_plot2.perc_G = df_plot2.perc_G + 1100
df_plot2.perc_B = df_plot2.perc_B + 1200

df_plot2
##
```

Out[86]:

Material	Color_dec	Med_Extrems	Max_Histog	Idx_Max_Histog	Min_Histog	Idx_Min_
Aluminum	167.77215	1127.833333	2553.353333	2090.333333	1170.000000	160.(
Brass	167.77215	1127.833333	1993.780000	2095.000000	771.666667	135.(
Copper	167.77215	1127.833333	1783.280000	2134.000000	920.500000	177.5
CopperWire	167.77215	1127.833333	1943.120000	2202.000000	607.250000	280.2
Iron	167.77215	1127.833333	3034.782500	2252.000000	882.500000	177.5
PaintedIron	167.77215	1127.833333	3583.540000	2253.000000	627.428571	185.1
StainlessSteel	167.77215	1127.833333	4000.684444	2252.777778	955.666667	271.1

In [87]:

```
loc_Array_sum = np.arange(len(df_plot1.index))
xtick_loc = list(loc_Array_sum)
xticks = list(df_plot1.index)

df_plot2.plot( y=['Color_dec','Med_Extrems', 'Max_Histog', 'Idx_Max_Histog',
            'Min_Histog','Idx_Min_Histog','perc_R','perc_G','perc_B'],figsize=(12,6),
grid=True )

plt.xticks(xtick_loc, df_plot1.index, rotation=0)
plt.title('IMAGE WITH ALL CHANNELS - Color and Histogram /'+xsheet,fontsize=18)
plt.xlabel('Material',fontsize=18)
plt.ylabel('Average of Color and Histogram',fontsize=18)
plt.legend(loc='upper right', ncol=3, fancybox=True, shadow=True)

plt.savefig(xsheet+'_Color_and_Histogram.png')   # Save  Figure
plt.show()
```



In [88]:

```
df_plot2.perc_R = df_plot2.perc_R - 1000
df_plot2.perc_G = df_plot2.perc_G - 1100
df_plot2.perc_B = df_plot2.perc_B - 1200
```

In [89]:

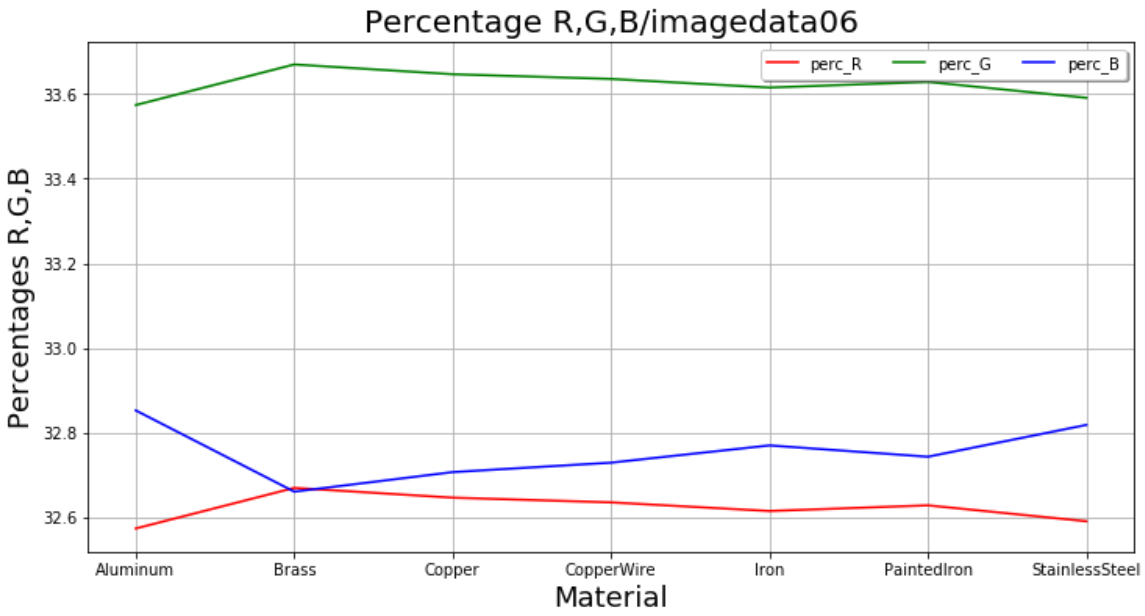
```
df_plot2.perc_R = df_plot2.perc_R - 1
df_plot2
```

Out[89]:

Material	Color_dec	Med_Extrems	Max_Histog	Idx_Max_Histog	Min_Histog	Idx_Min_
Aluminum	167.77215	1127.833333	2553.353333	2090.333333	1170.000000	160.(
Brass	167.77215	1127.833333	1993.780000	2095.000000	771.666667	135.(
Copper	167.77215	1127.833333	1783.280000	2134.000000	920.500000	177.5
CopperWire	167.77215	1127.833333	1943.120000	2202.000000	607.250000	280.2
Iron	167.77215	1127.833333	3034.782500	2252.000000	882.500000	177.5
PaintedIron	167.77215	1127.833333	3583.540000	2253.000000	627.428571	185.1
StainlessSteel	167.77215	1127.833333	4000.684444	2252.777778	955.666667	271.7

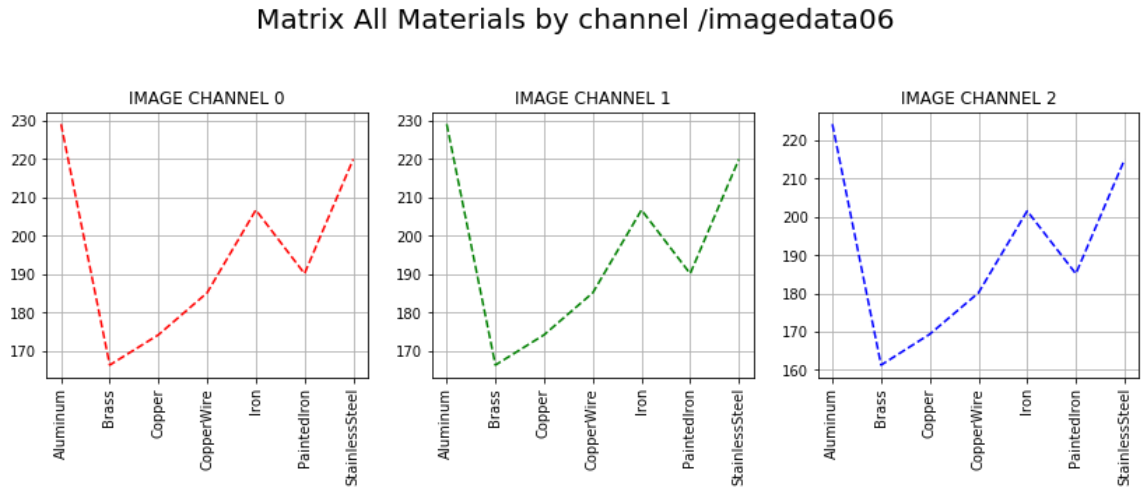
In [90]:

```
loc_Array_sum = np.arange(len(df_plot1.index))
xtick_loc = list(loc_Array_sum)
xticks = list(df_plot1.index)

df_plot2.plot(y=["perc_R","perc_G","perc_B"],
              figsize=(12,6), grid=True, color=('r','g','b') )

#-------

#plt.plot(df_plot.Array_sum)
plt.title('Percentage R,G,B'+'/'+xsheet,fontsize=20)
plt.ylabel('Percentages R,G,B',fontsize=18)
plt.xticks(xtick_loc, df_plot1.index, rotation=0)
plt.xlabel('Material',fontsize=18)
plt.legend(loc='upper right', ncol=3, fancybox=True, shadow=True)
plt.savefig(xsheet+"_Line Graph Percentage RGB.png")
plt.show()
```



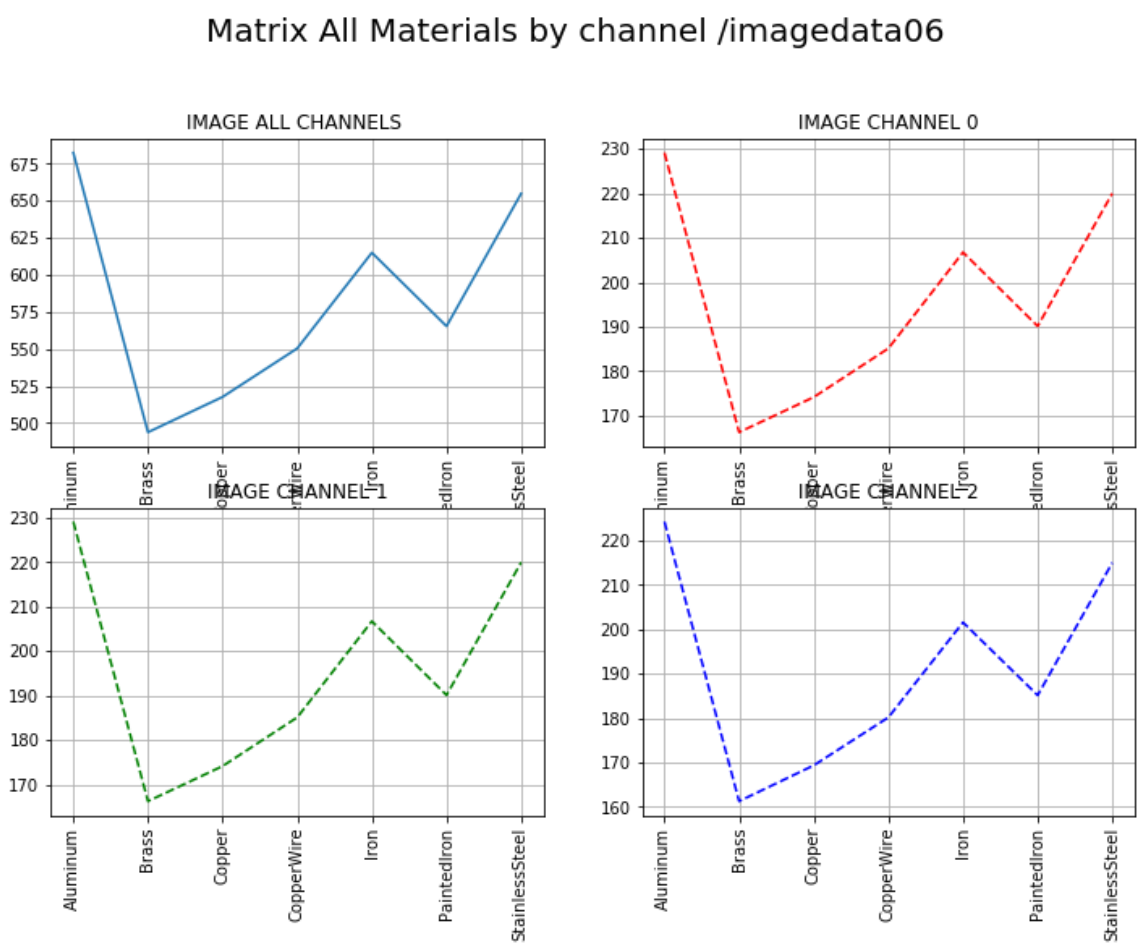
In [91]:

```
# Plot Channel separately
# Create pivot table
df_plot3 = df.groupby('Material')['All_Bands','Sum_Ch0', 'Sum_Ch1', 'Sum_Ch2'].mean()
df_plot3

import matplotlib.gridspec as gridspec

fig = plt.figure(figsize=(14,8))
gs0 = gridspec.GridSpec(2, 1)   # Spaces between graphics
fig.subplots_adjust(top=0.85)
fig.suptitle('Matrix All Materials by channel /'+xsheet,size=20) # or plt.suptitle('Mai
n title')
plt.tight_layout()

plt.subplot(231)
plt.title('IMAGE CHANNEL 0')
plt.xticks(rotation=90)
plt.grid(True)
plt.plot(df_plot3.Sum_Ch0, 'r--')

plt.subplot(232)
plt.title('IMAGE CHANNEL 1')
plt.xticks(rotation=90)
plt.grid(True)
plt.plot(df_plot3.Sum_Ch1,  'g--')

plt.subplot(233)
plt.title('IMAGE CHANNEL 2')
plt.xticks(rotation=90)
plt.plot(df_plot3.Sum_Ch2,  'b--')
plt.grid(True)
#plt.legend(loc='upper right', ncol=3, fancybox=True, shadow=True)

plt.savefig(xsheet+'_Matrix_Channels.png')   # Save  Figure
plt.show()
```



In [92]:

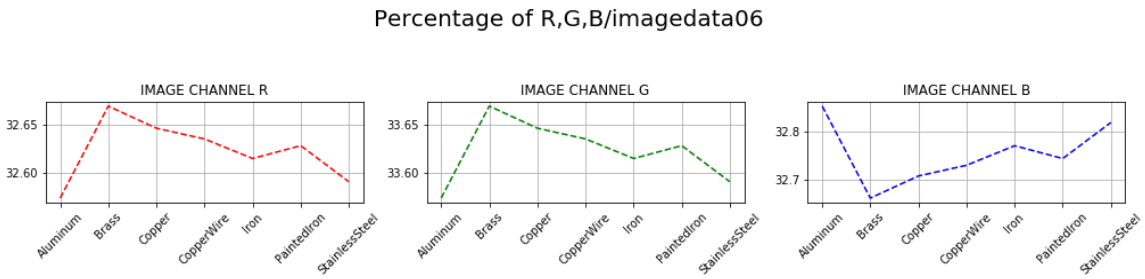
```
import matplotlib.gridspec as gridspec


fig = plt.figure(figsize=(12,8))
gs0 = gridspec.GridSpec(2, 1)   # Spaces between graphics

for i in range(1,5):
    ax=fig.add_subplot(2,2,i)

    plt.xticks(rotation=90)
    if i == 1:
        ax=plt.plot(df_plot3.All_Bands)
        plt.grid(True,which="both",ls="-")
        plt.title('IMAGE ALL CHANNELS ')
    if i == 2:
        ax=plt.plot(df_plot3.Sum_Ch0, 'r--')
        plt.grid(True,which="both",ls="-")
        plt.title('IMAGE CHANNEL 0')
    if i == 3:
        ax=plt.plot(df_plot3.Sum_Ch1, 'g--')
        plt.grid(True,which="both",ls="-")
        plt.title('IMAGE CHANNEL 1')
    if i == 4:
        ax=plt.plot(df_plot3.Sum_Ch2, 'b--')
        plt.grid(True,which="both",ls="-")
        plt.title('IMAGE CHANNEL 2')

        # Tight layout often produces nice results
# but requires the title to be spaced accordingly
fig.subplots_adjust(top=0.85)
fig.suptitle('Matrix All Materials by channel /'+xsheet,size=20) # or plt.suptitle('Mai
n title')
plt.show()
```


Matrix All Materials by channel /imagedata06
IMAGE ALL CHANNELS
IMAGE CHANNEL 0
IMAGE CHANNEL 1
IMAGE CHANNEL 2
Aluminum
Brass
Copper
CopperWire
Iron
PaintedIron
StainlessSteel

In [93]:

```
# Pèrcentage of R,G,B
plt.figure(1)
plt.figure(figsize=(17, 4))
plt.tight_layout()
plt.subplot(231)
plt.title('IMAGE CHANNEL R')
plt.xticks(rotation=45)
plt.grid(True)
plt.plot(df_plot2.perc_R, 'r--')

plt.subplot(232)
plt.title('IMAGE CHANNEL G')
plt.xticks(rotation=45)
plt.grid(True)
plt.plot(df_plot2.perc_G,  'g--')

plt.subplot(233)
plt.title('IMAGE CHANNEL B')
plt.xticks(rotation=45)
plt.plot(df_plot2.perc_B,  'b--')
plt.grid(True)

plt.suptitle('Percentage of R,G,B'+'/'+xsheet,fontsize=20,y=1.08)
#plt.tight_layout()
plt.subplots_adjust(top=0.8)
plt.savefig(xsheet+'_Percentage_RGB.png', bbox_inches='tight', pad_inches=0.0)
plt.show()
```

```
<Figure size 432x288 with 0 Axes>
```



In [59]:

```
print("Finished")
```

```
Finished
```

In [ ]: