ML/AI Assisted Fault Detection in Foundry Processed Devices

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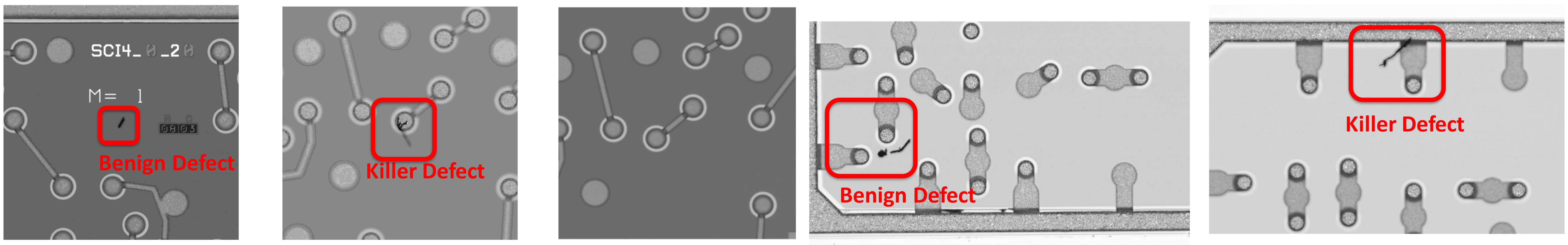
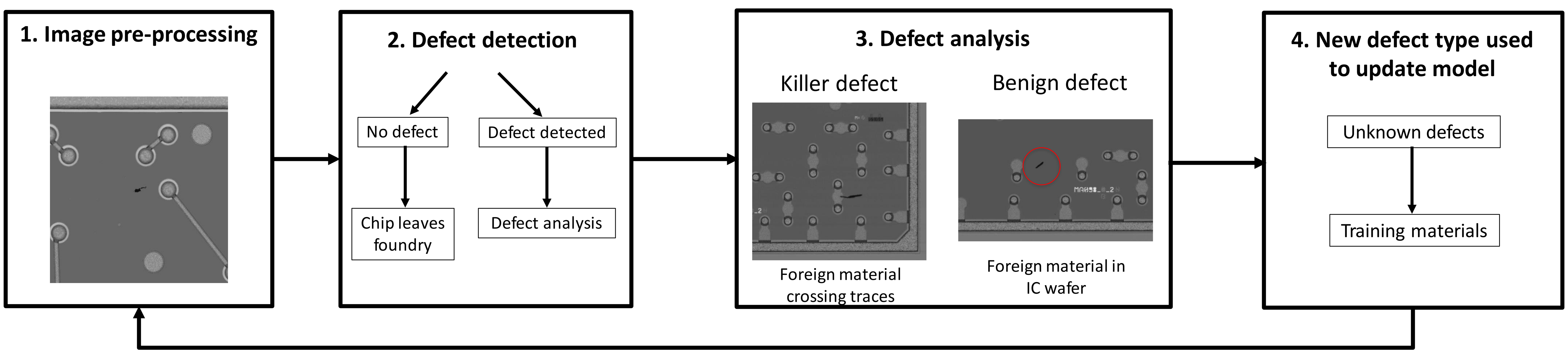
Problem: Defect detection in foundries is human-centric, slow, and costly



Matching image from Golden Reference

Highly accurate fault detection in foundry produced microelectronics is **crucial** to ensuring **quality** of devices that leave the foundry. However, many current IC defect detection flows are human-centric and have potential to be a **bottleneck** in the foundry. This is largely because certain classes of manufacturing defects are acceptable, but current defect detection tools in microelectronics foundry do not have the means to differentiate between benign and killer defects. The objective of this study is to find ways to leverage recent advances in AI/ML to **enhance and accelerate** the fault detection flow

Automatic and Accurate Detection of IC Defects

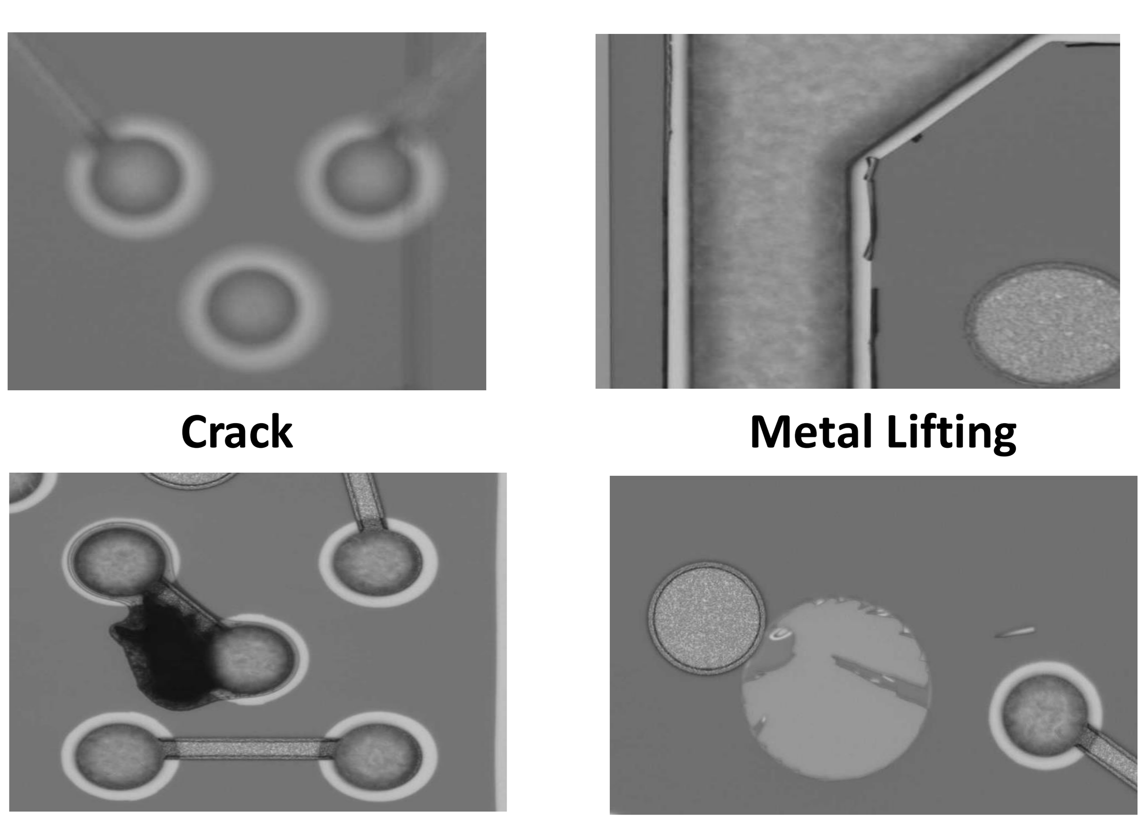


To solve this problem, we take the following approach: First, **image pre-processing** is performed to **highlight differences** between newly manufactured device and a reference design. Then, **defect detection models** are used to determine whether the device has a defect or not. If a defect is detected, another set of **defect analysis models** are used to determine whether the defect is **killer or benign**. In the case of an **unknown defect**, a human is called in to classify the new defect, which is then incorporated into training materials and used to **update defect detection and analysis models** without retraining.

Our Approach: CNNs, anomaly detection, segmentation models, and ensemble models are used to detect and classify defects

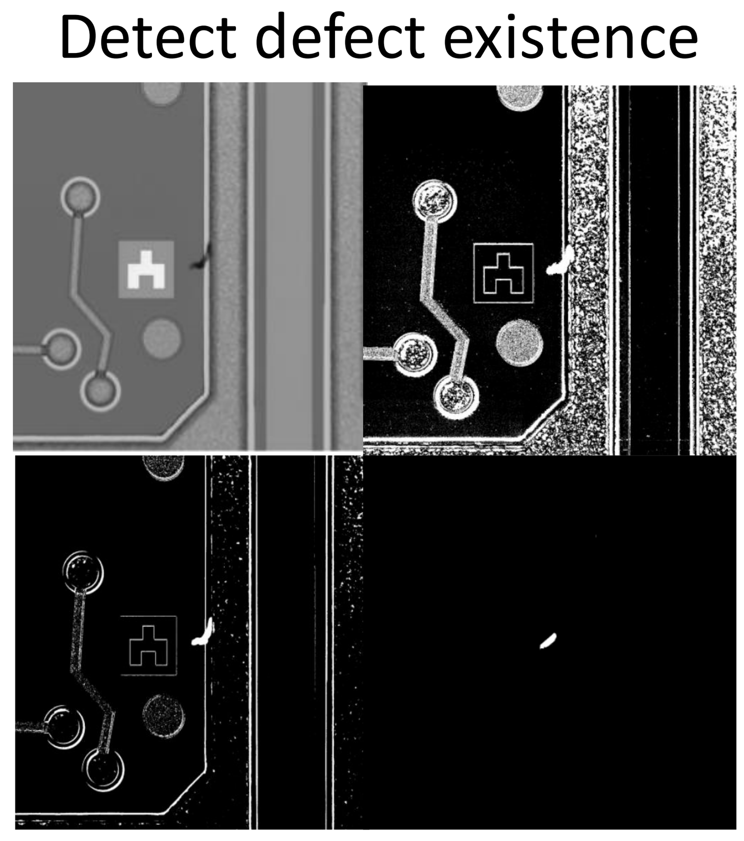
Defects Collection

Example of Killer Defects



CNN models for Classification

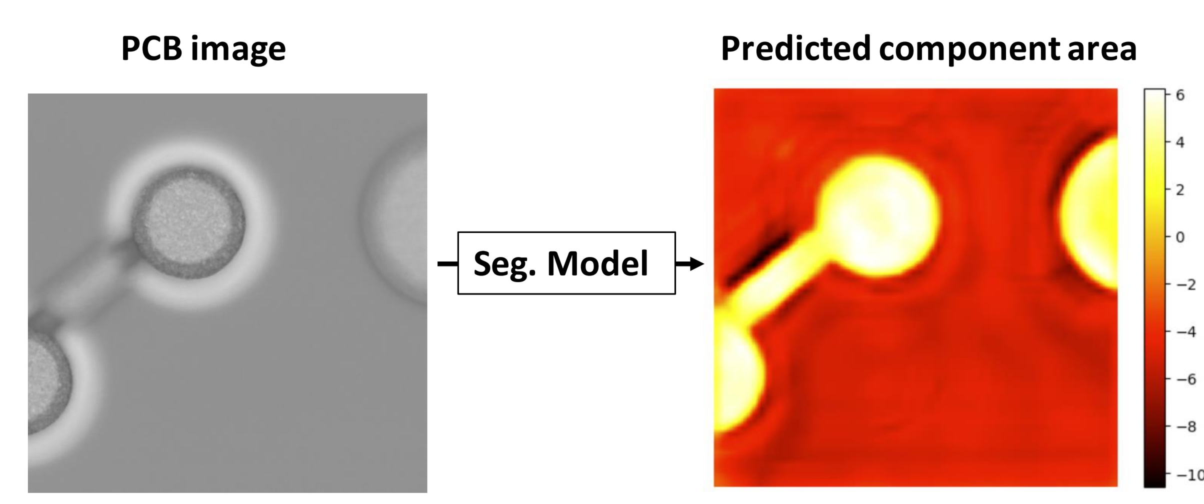
Detect defect existence



In order to clarify, highlight defects and subtract good-working non defect area, we apply image processing before performing CNN model training.

Segmentation Model

Segment image into component or background



Semantic segmentation model predicts what parts of the image belong to components, with 98% accuracy (IoU)

Classifying or segmenting parts of the image is important as killer defects often intersect component areas

Potential Impacts on fault detection in foundries
Quickly differentiate benign vs killer defects, then categorize the killer defects
Incorporate new faults as they are identified without retraining
Reduce foundry costs through the use of machine learning
Reduce dependency on human operators improves quality control
Increase foundry throughput

Next Steps: Localized Anomaly Detection

location specific detection ensembled with segmentation model