



We are one spot for your Image Analysis

WE ARE ONE SPOT FOR SOLVING COMPLEX
IMAGE ANALYSIS APPLICATIONS IN THE
MATERIALS SCIENCE FIELD.



SciSpot – Scientific Solutions (MIPAR Distributor in Europe)

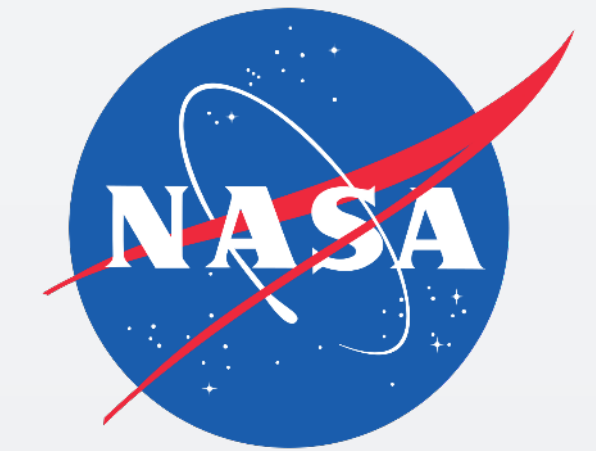
SciSpot specializes in supporting customers across all industry sectors that conduct Product Research & Development and Quality & Control. Our mission is to help our clients navigate a complex technology landscape and bring value across the entire customer chain, from IT to end-users. Together with us, you will start a journey of discovery, experiencing how image analysis and data analytic technologies can support you in solving complex design and manufacturing challenges – making your business even more competitive and sustainable.

MIPAR Image Analysis is a world-leading algorithm development and image analysis software company.

We specialize in efficiently, accurately, and reliably extracting measurements from complex images. From material and life sciences to aerospace and manufacturing solutions, our extensive portfolio can assist various real-world applications. Our flagship MIPAR product offers an intuitive user experience, drag-and-drop custom algorithm development, and a powerful deep learning toolbox. Combined with expert consultative services, we offer clients an end-to-end solution that suits their particular project needs. MIPAR helps clients implement sophisticated algorithms that save time and cost while increasing accuracy and supervision over results.

Introduction to MIPAR

- ✓ Started in materials science
- ✓ Invented at research university
- ✓ Developed by actual users
- ✓ Spun-out in 2017
- ✓ 100s of schools and companies
- ✓ In over 40 countries



PennState



NATIONWIDE
CHILDREN'S



IOWA STATE
UNIVERSITY

U OF SCHOOL OF
MEDICINE

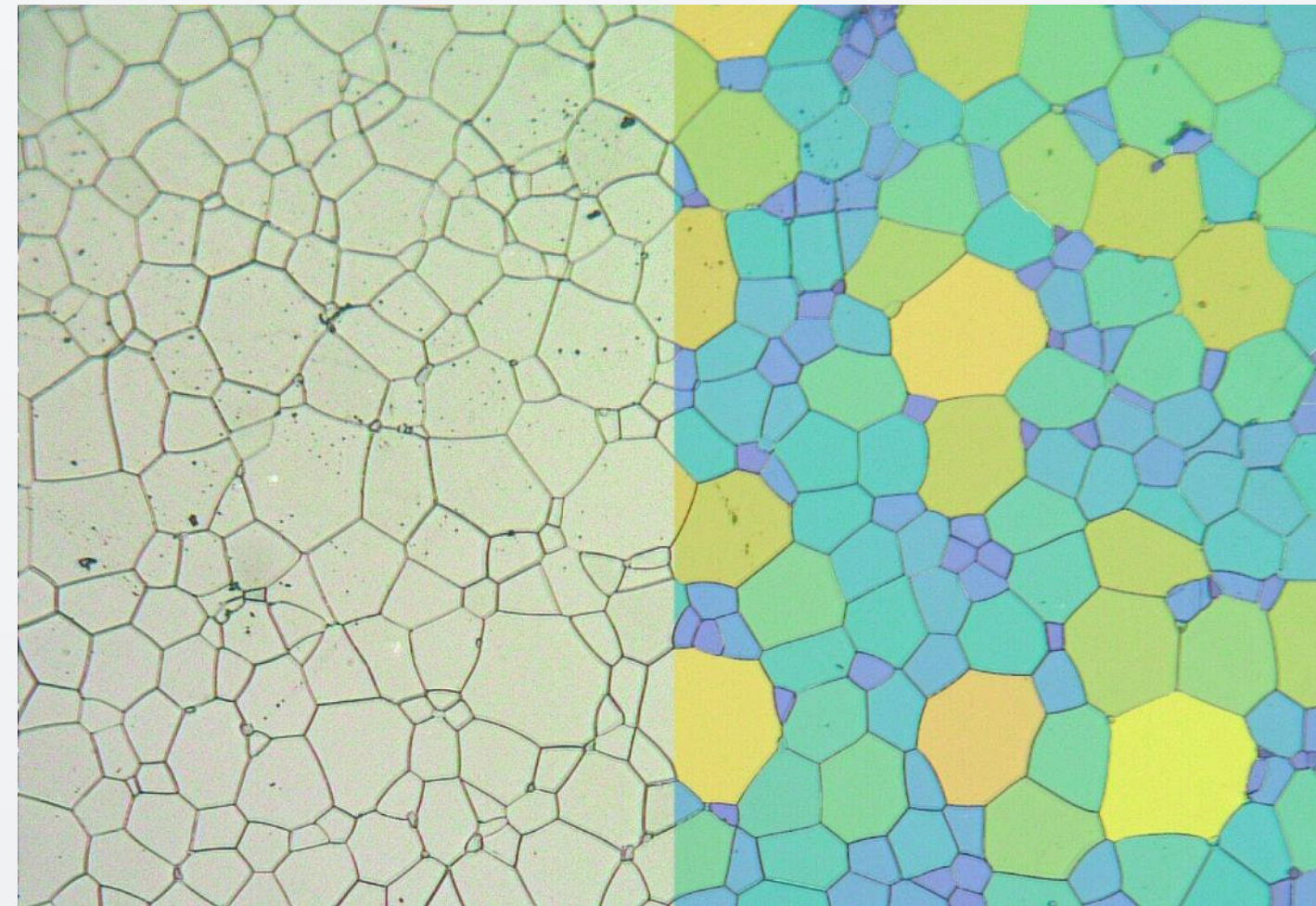
DARTMOUTH



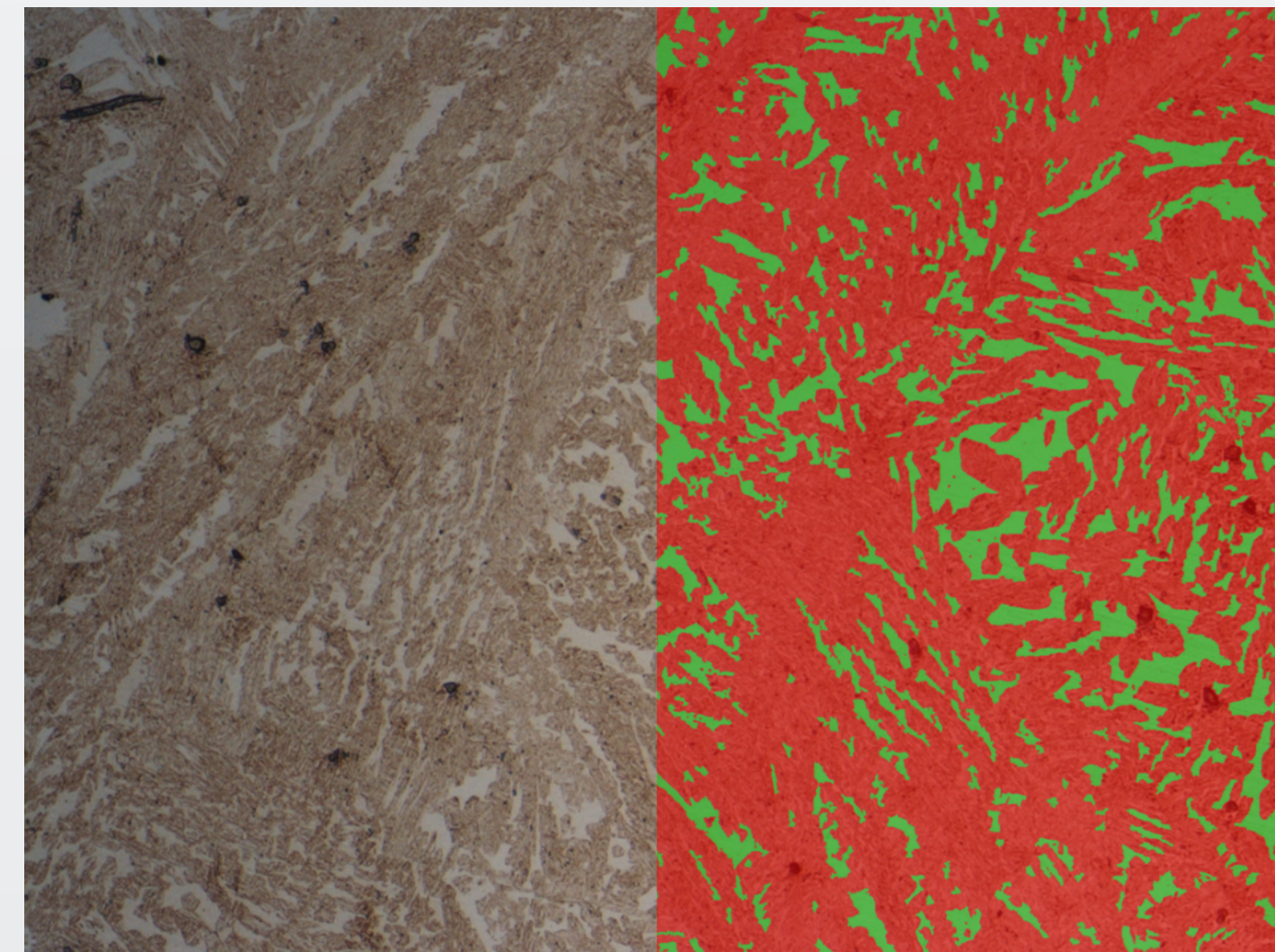
STEVENS
INSTITUTE of TECHNOLOGY
THE INNOVATION UNIVERSITY®

What is possible with Image Analysis for Metals Characterization?

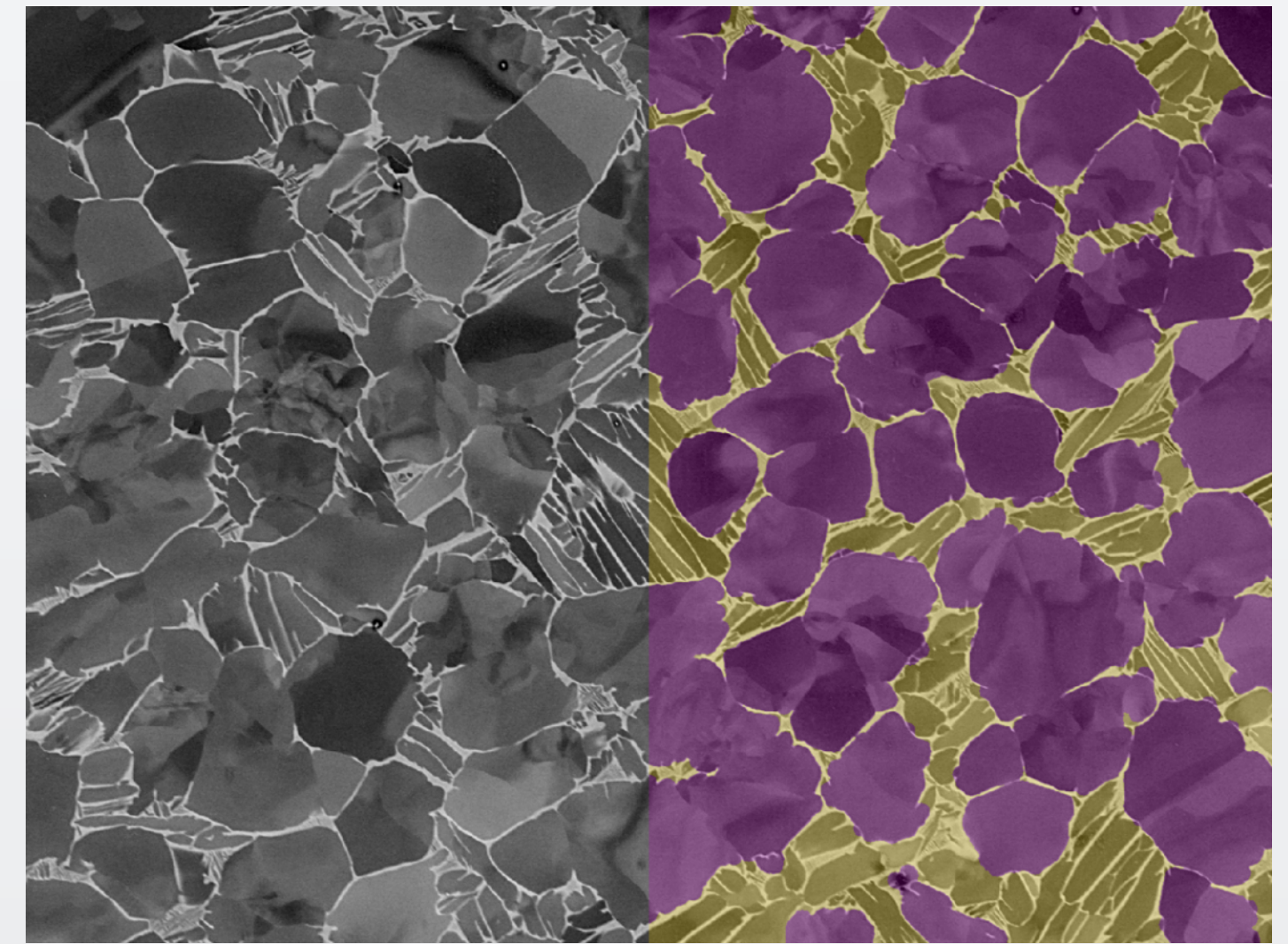
- ✓ Phase Analysis
- ✓ Grain Size Analysis
- ✓ Porosity Analysis
- ✓ Inclusions Analysis
- ✓ Layer Thickness Analysis
- ✓ Particle Analysis
- ✓ Defect Analysis
- ✓ Many more...



Copper alloy grain size measurement following ASTM E-112 standard.



Segments ferrite from surrounding martensite in martensitic stainless steel weld cross-sections.

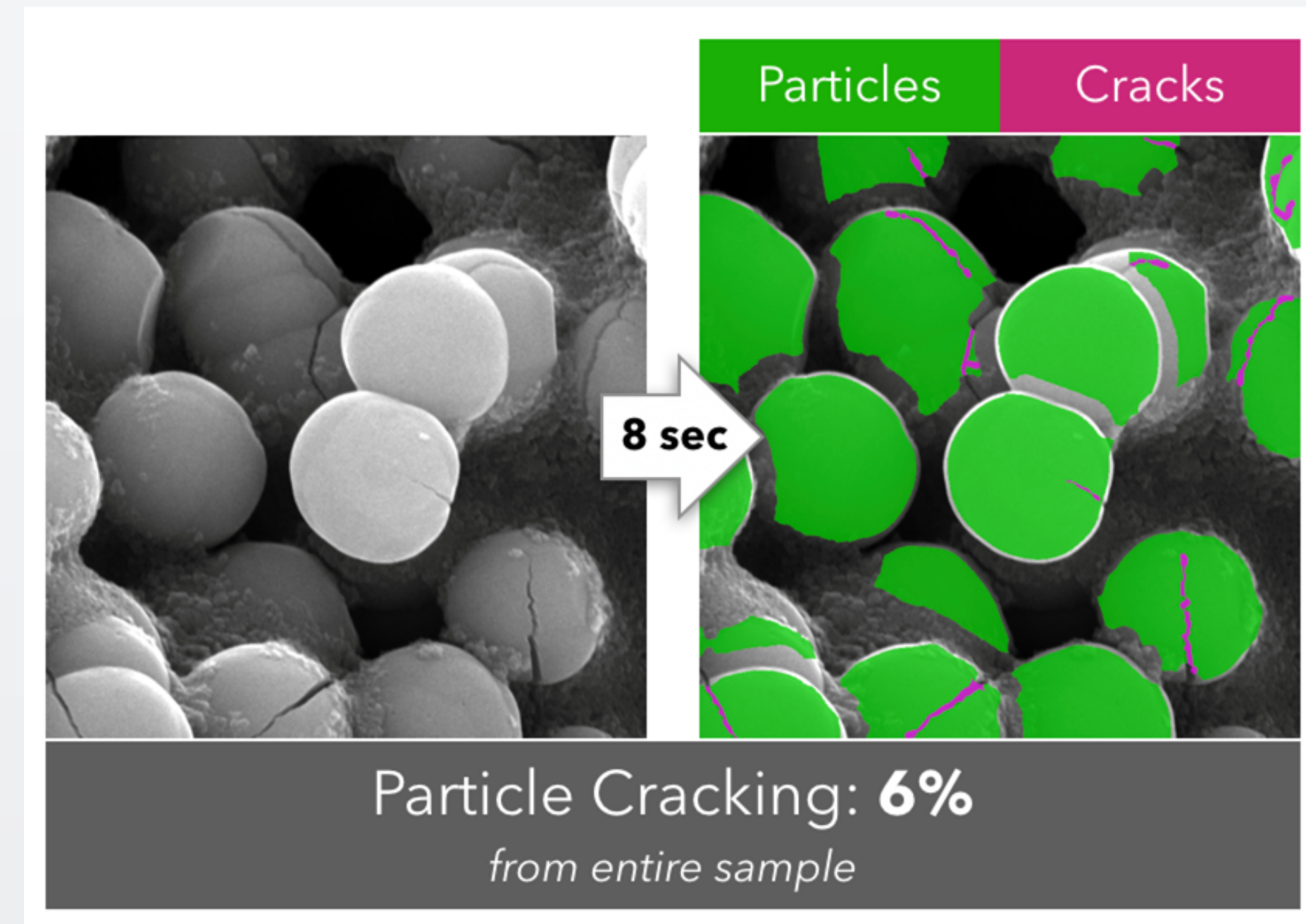


Segments rounder particles from acicular features in [α+β]-processed Ti-alloy microstructures.

Analysis Challenges

Challenges:

- Image analysis expertise
- Operator bias
- Long analysis time
- Low accuracy and reproducibility
- Difficult, complicated images
- Noisy microstructures
- Poor sample prep (scratches)
- Ambiguous feature boundaries
- Wide variety of contrast conditions
- Features of similar grey values
- Poor contrast



Deep learning addresses all these challenges, it improves image analysis, increases accuracy and throughput, without any image analysis expertise.

MIPAR Image Analysis Software



Power: Solve problems others can't, thanks to powerful Recipes



Speed: Solve problems faster with intuitive design and batch processing



Versatility: Solve problems across many application areas



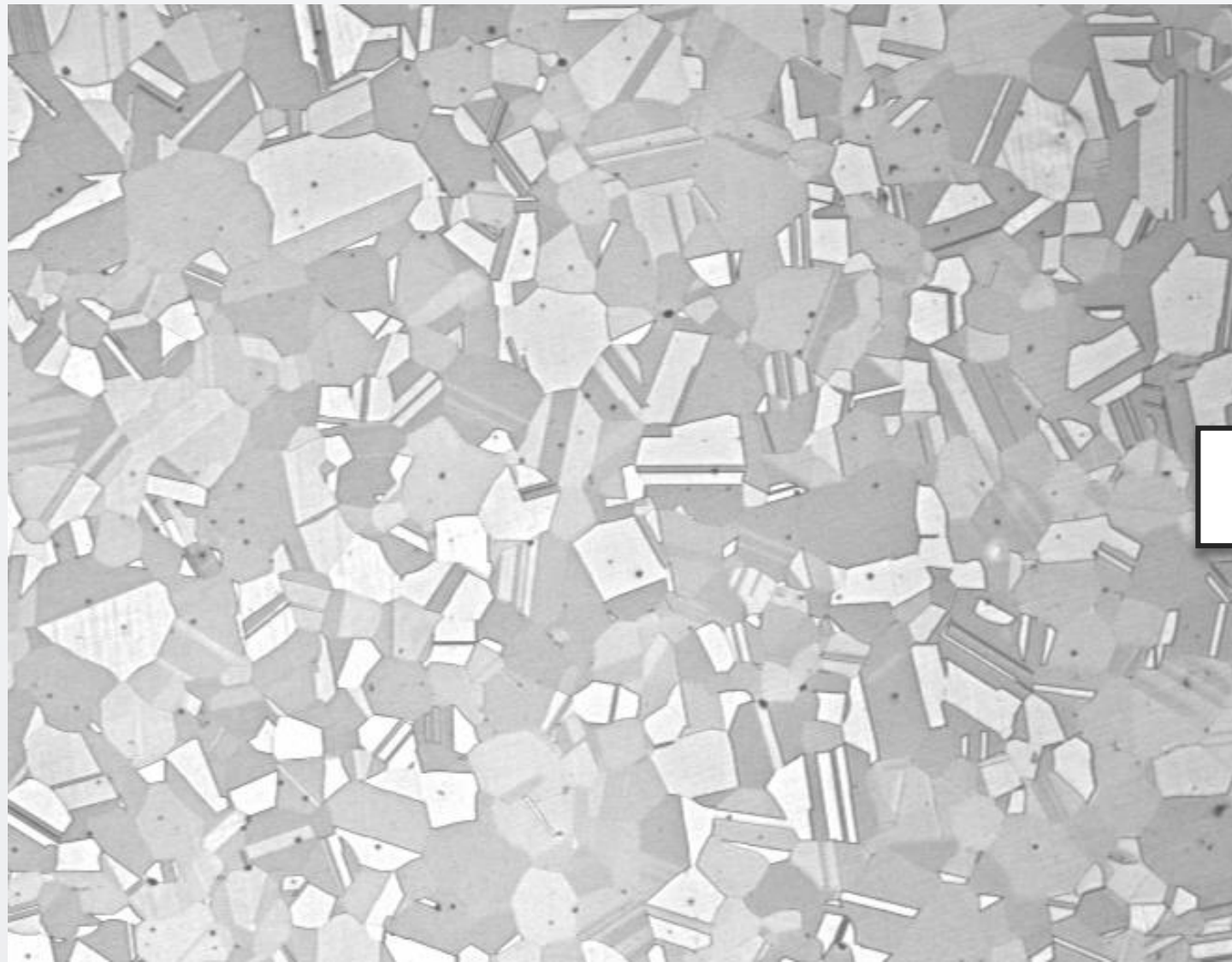
Objectivity: Reduce subjectivity in analysis using the Optimization Engine



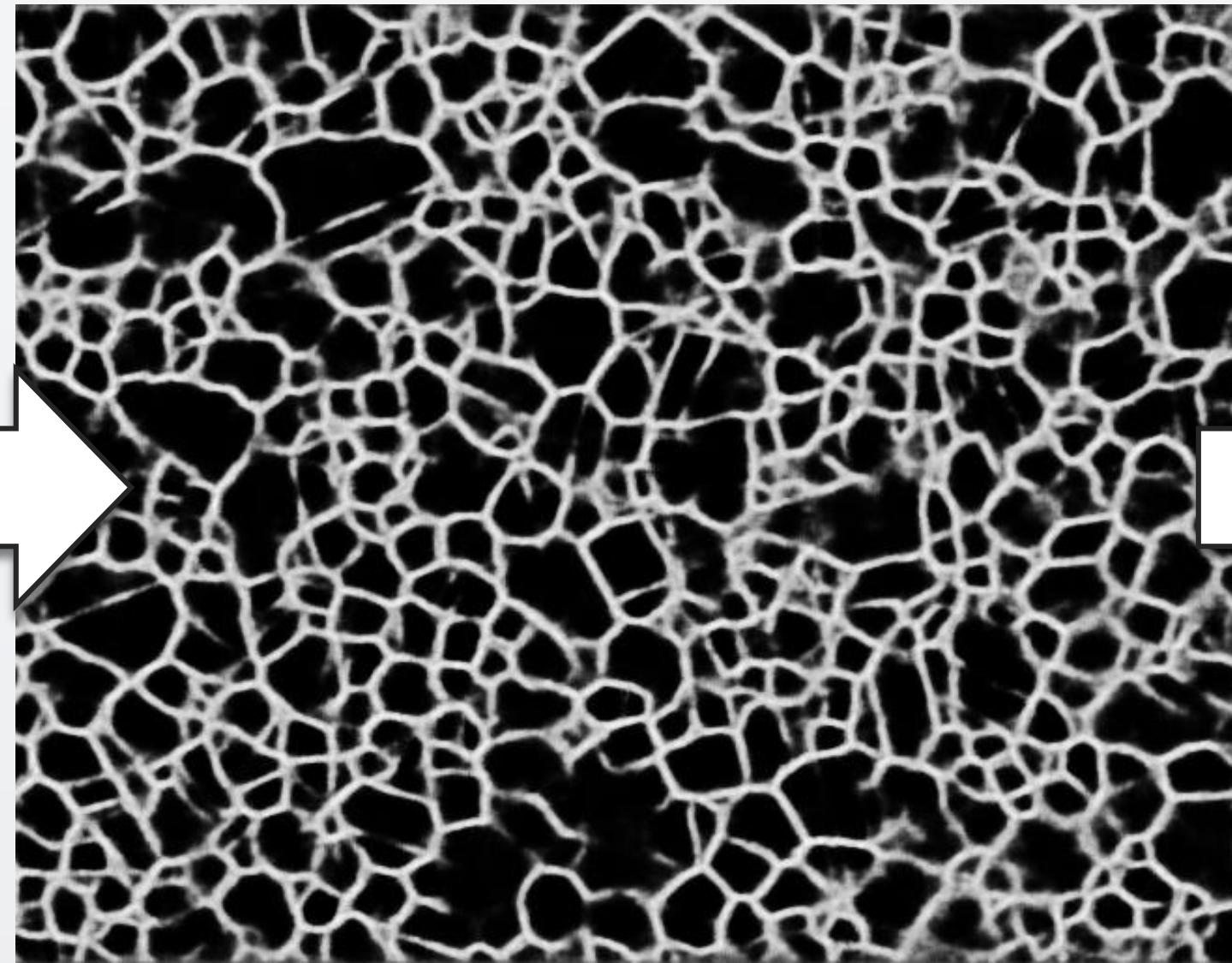
Expertise: Call on experts to rapidly deliver custom solutions

Grain Analysis - Twinned Grains in Brass

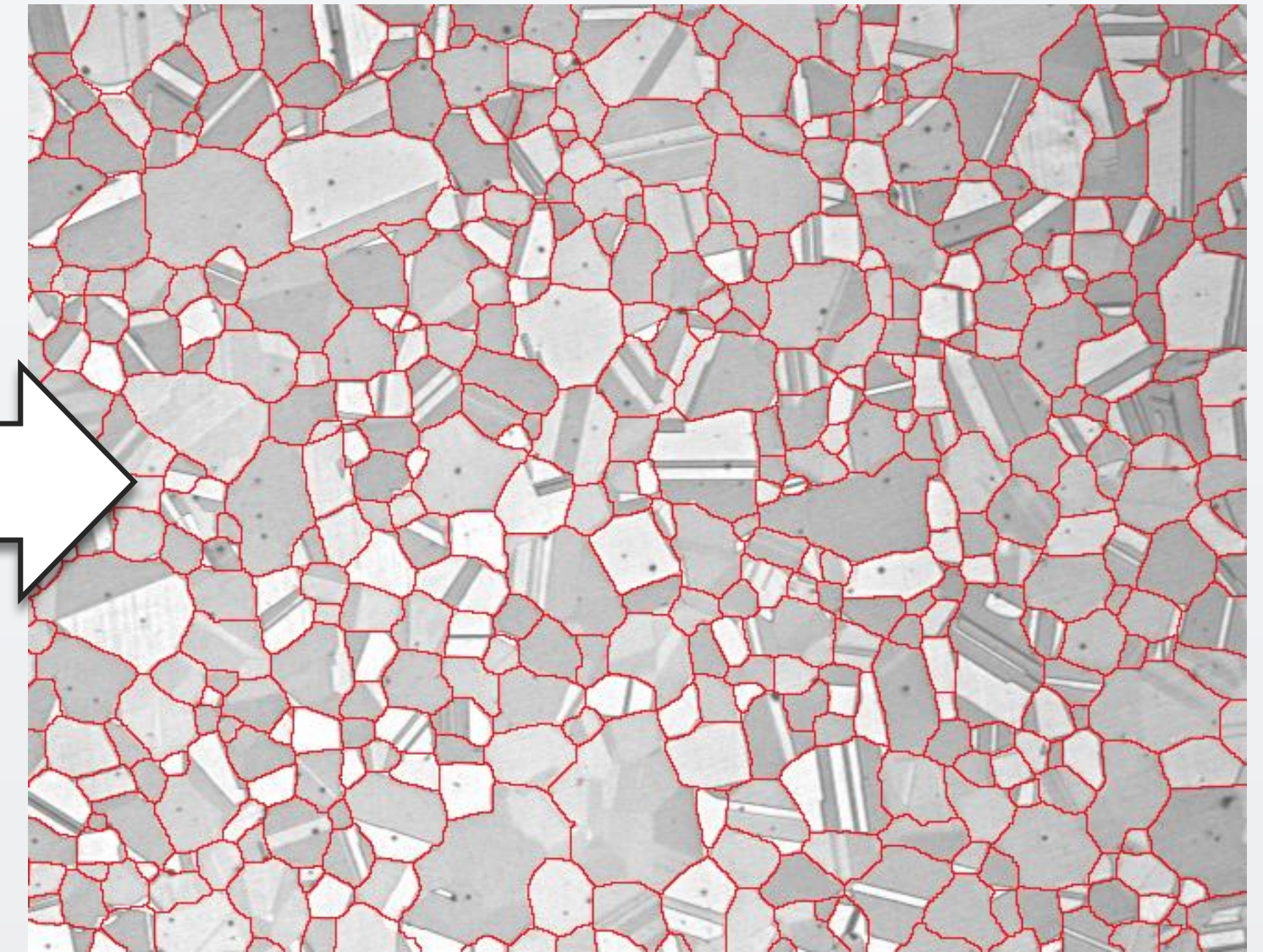
Original Image



Deep Learning Applied



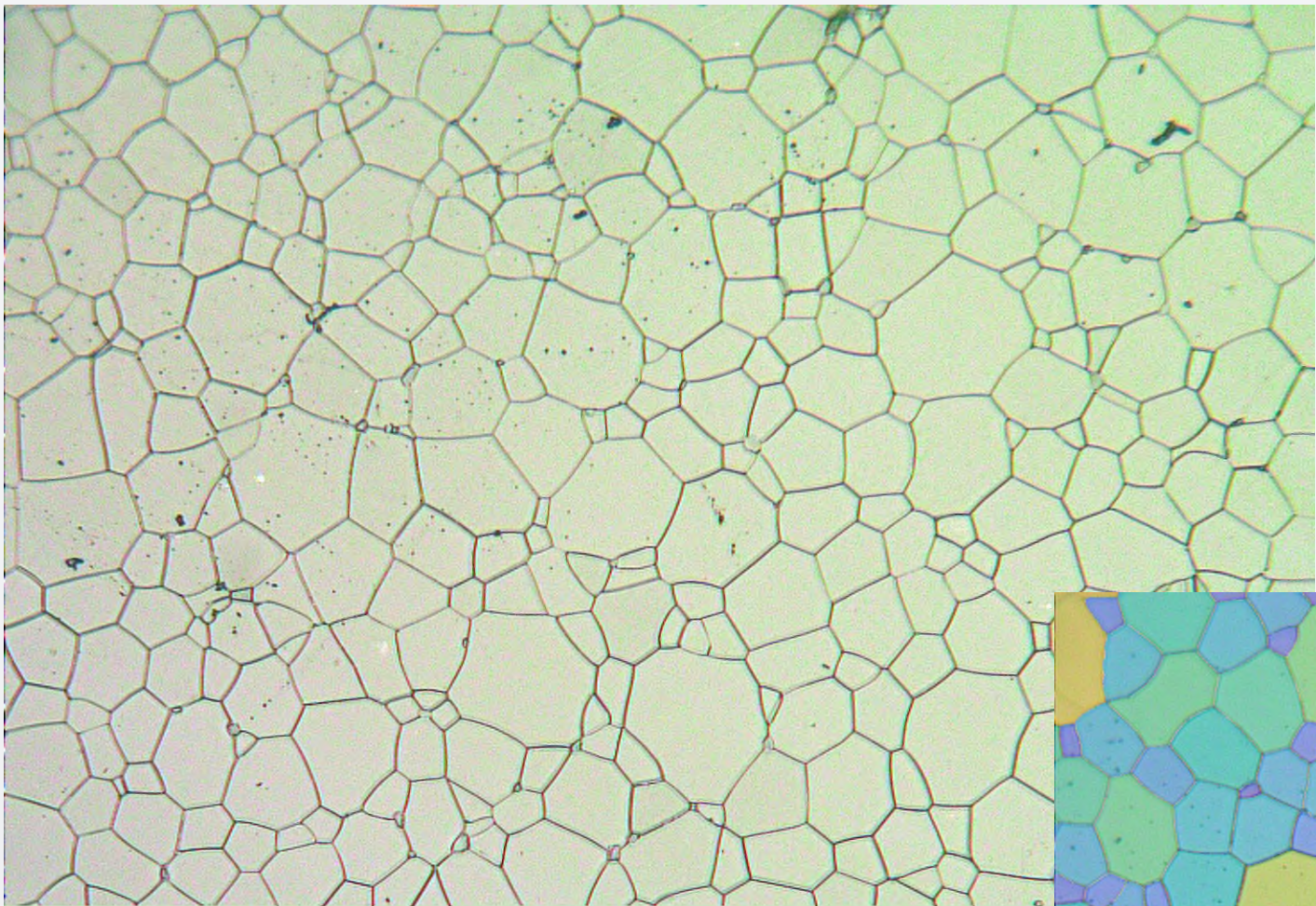
Final Segmentation



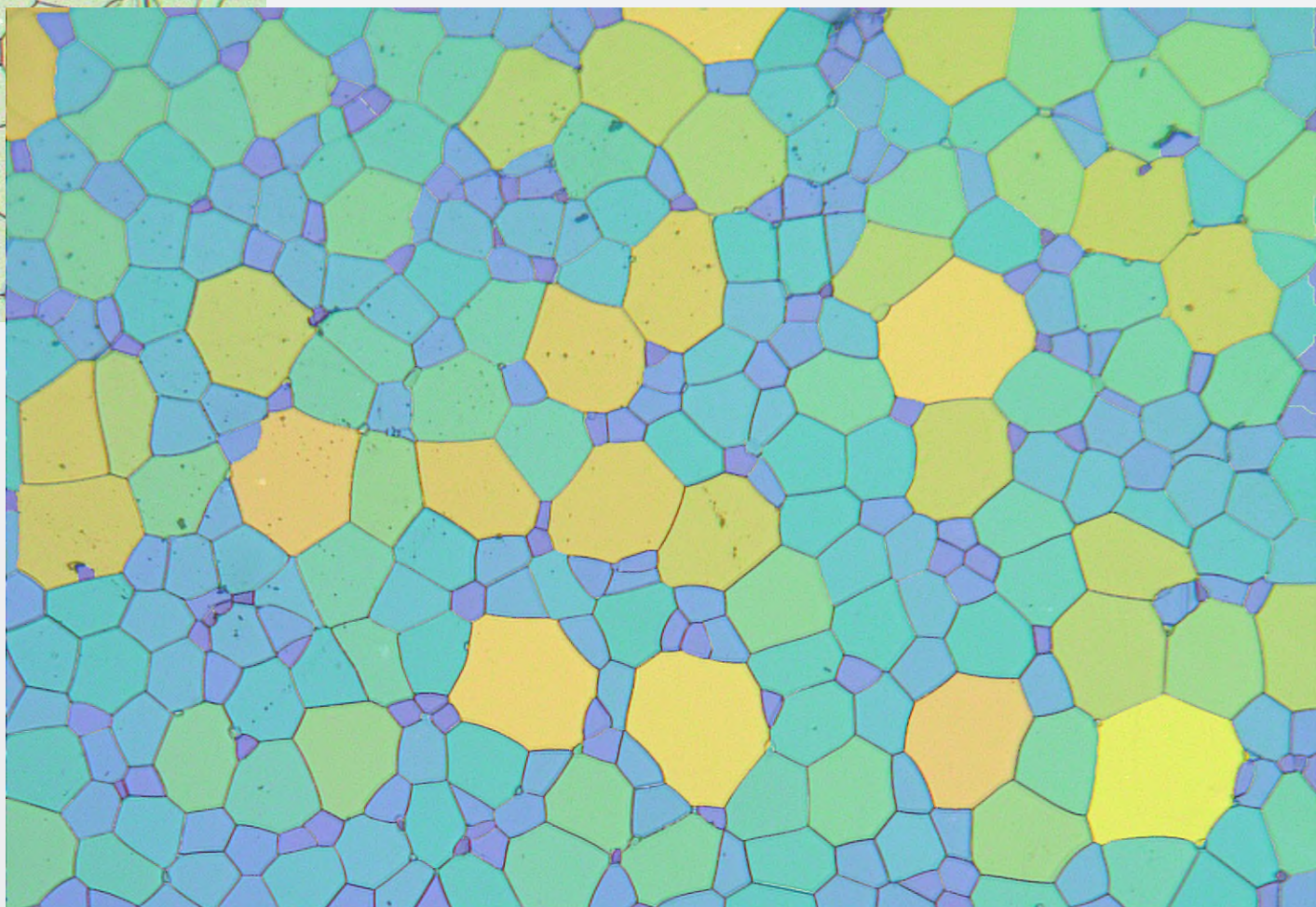
- ✓ Automated measurement of complex grains despite poor contrast
- ✓ Replace manual tracing
- ✓ Deep learning enables highly complex classification

Grain Analysis – Copper Alloy

Original



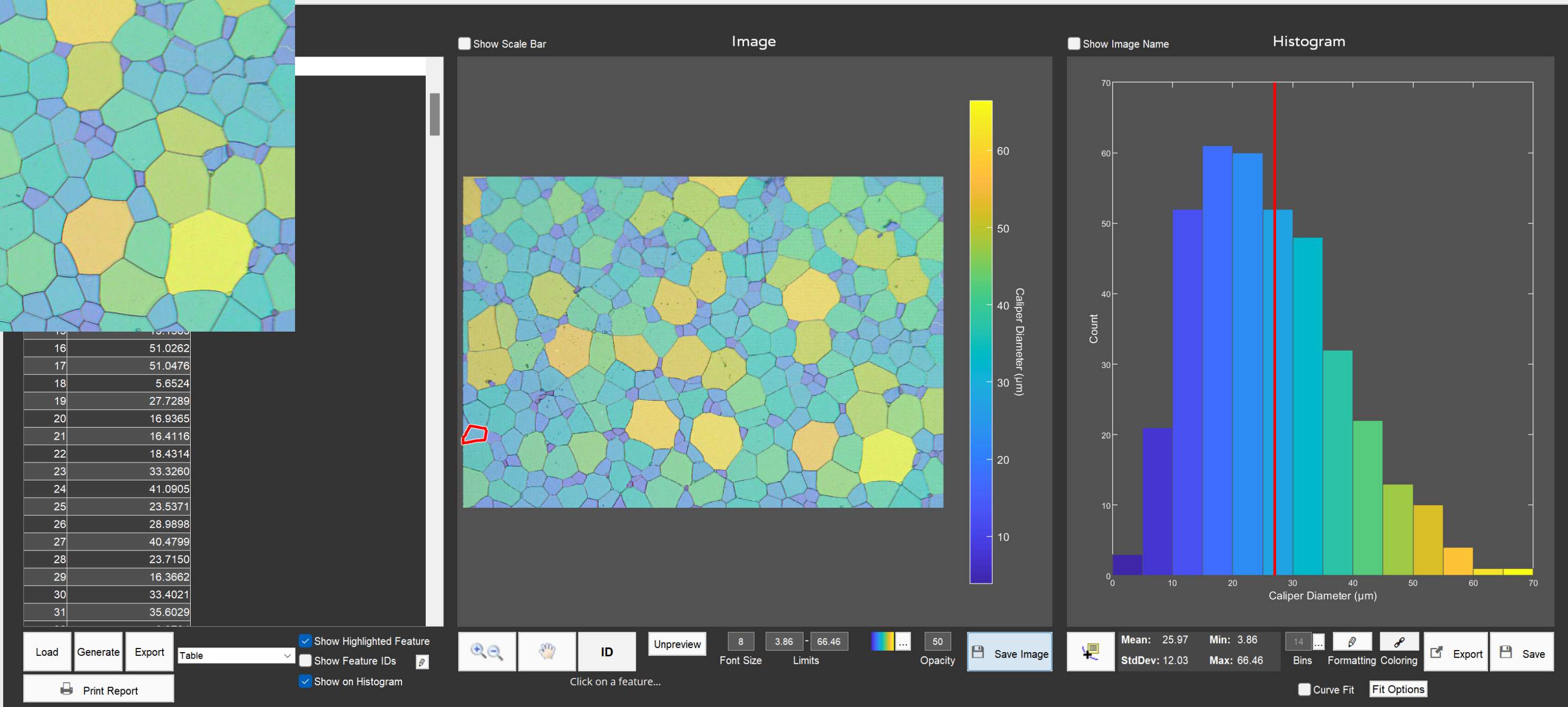
Identified Grains



✓ Measurements meet ASTM-E112 grain size guidelines

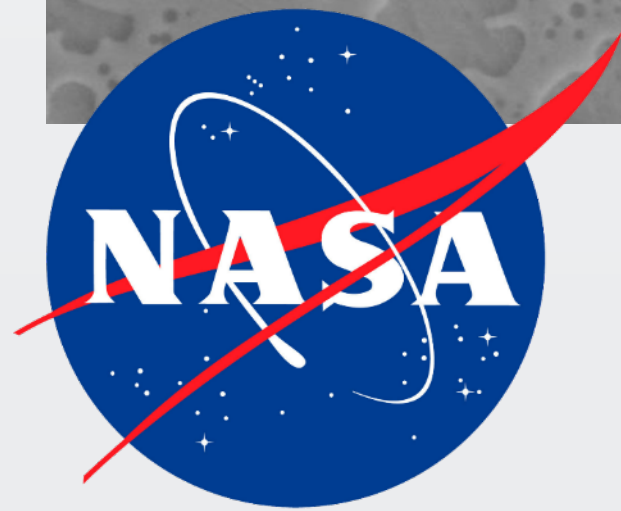
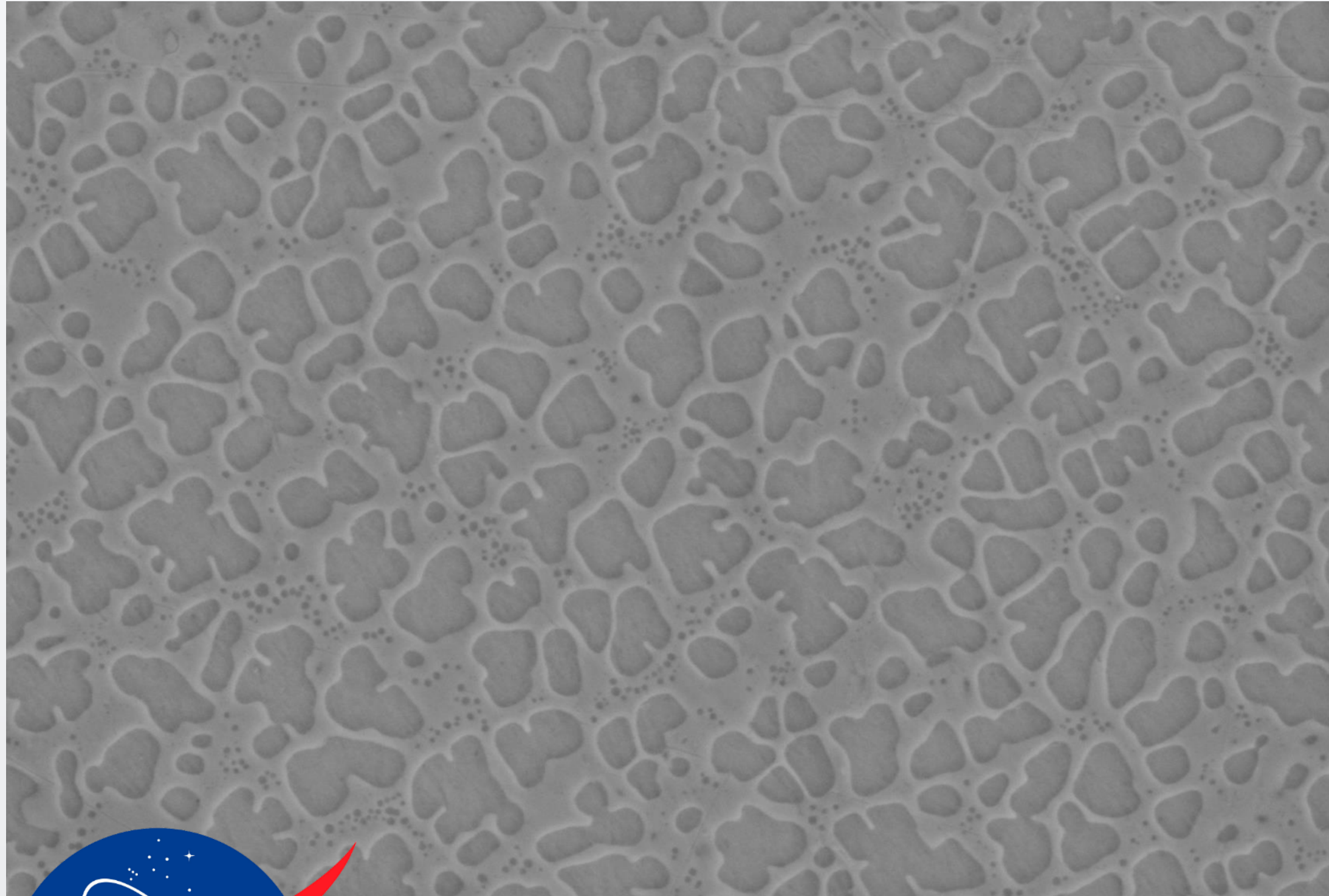
✓ Automated, unbiased results

Grain Size Measurements



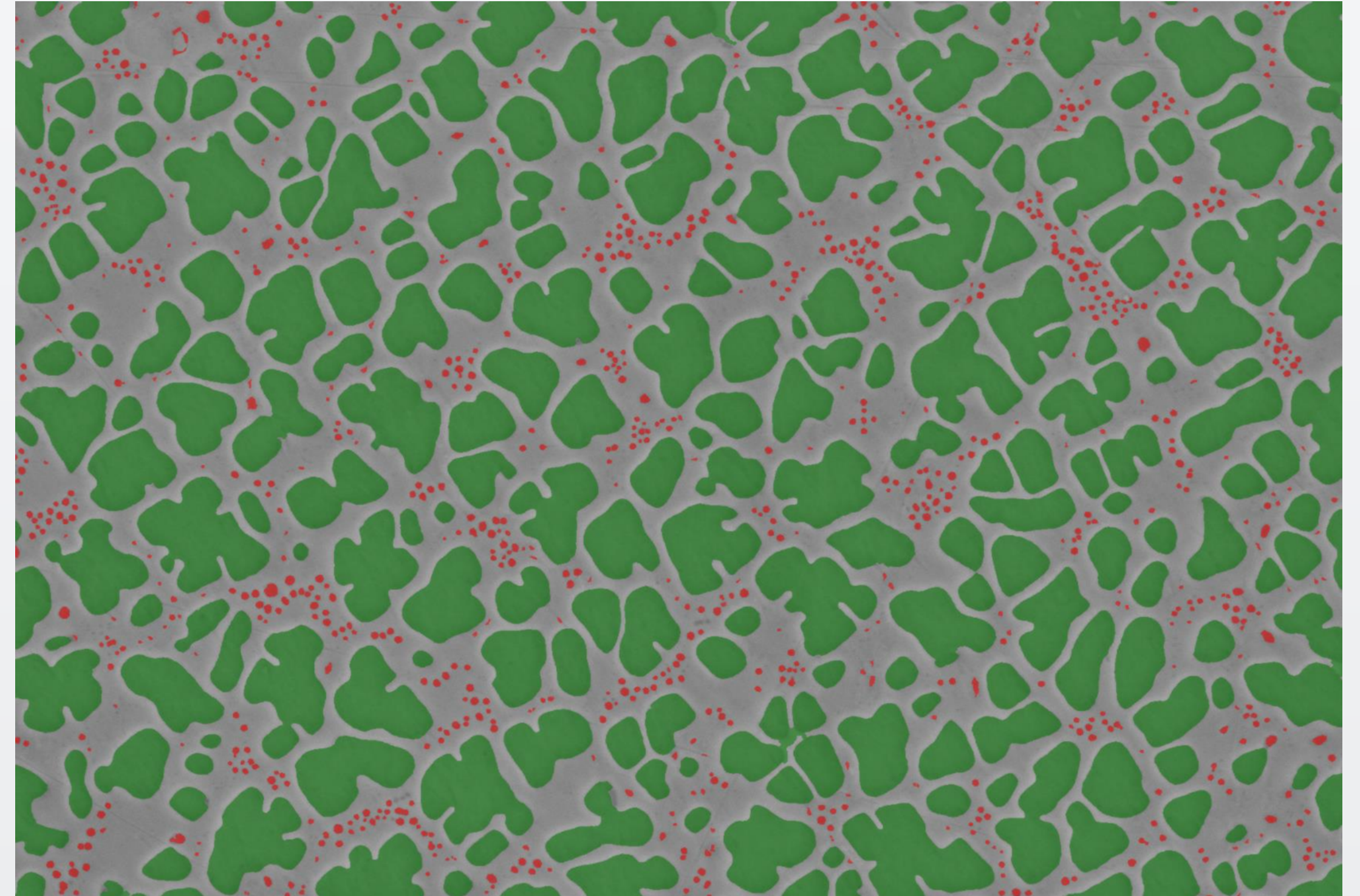
Phase Analysis – Particles in Nickel-base Superalloy

Original



T.M. Smith, P. Bonacuse, J. Sosa, M. Kulis, L. Evans, *A quantifiable and automated volume fraction characterization technique for secondary and tertiary γ' precipitates in Ni-based superalloys*, Materials Characterization, Volume 140, 2018, Pages 86-94

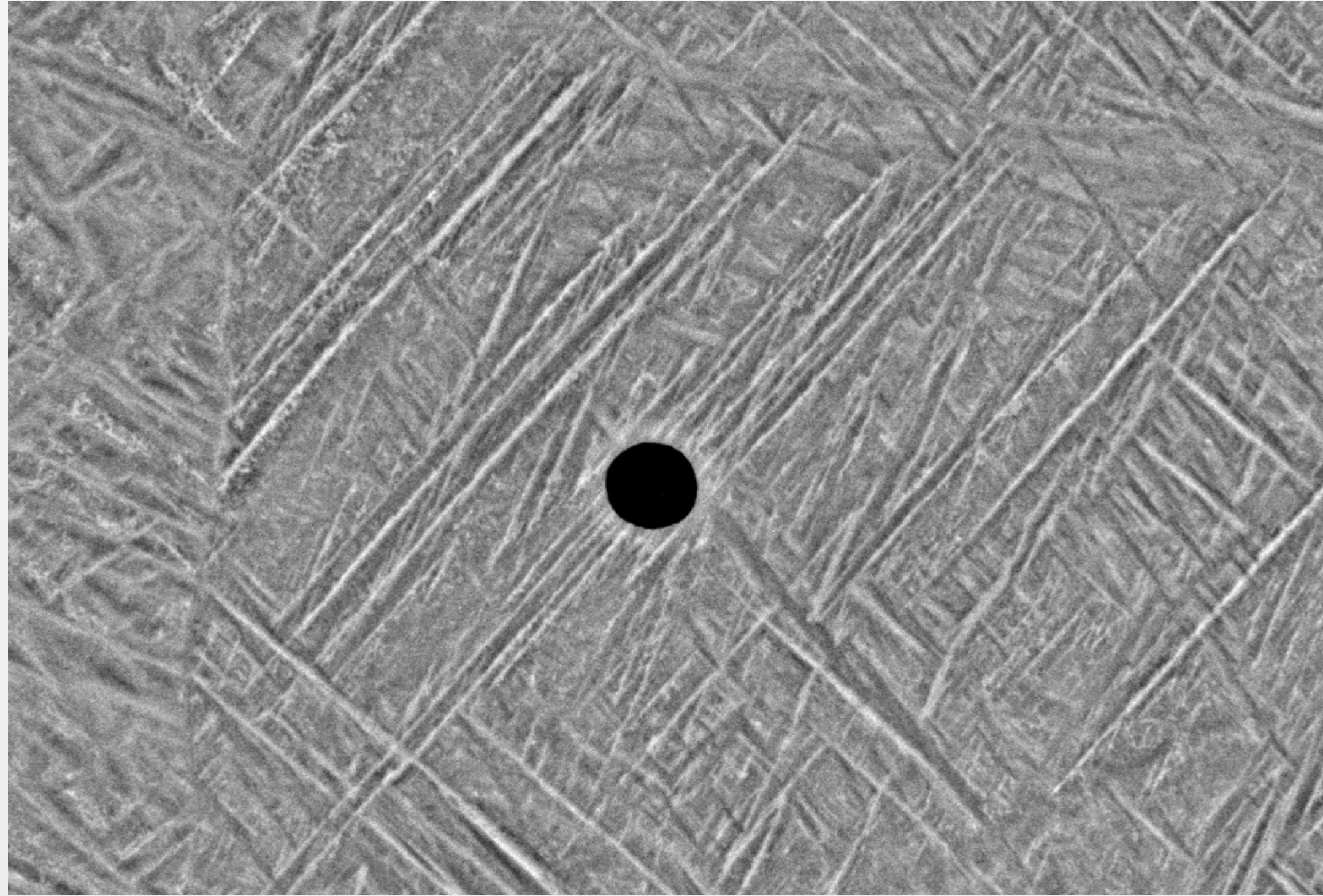
Particle
detection



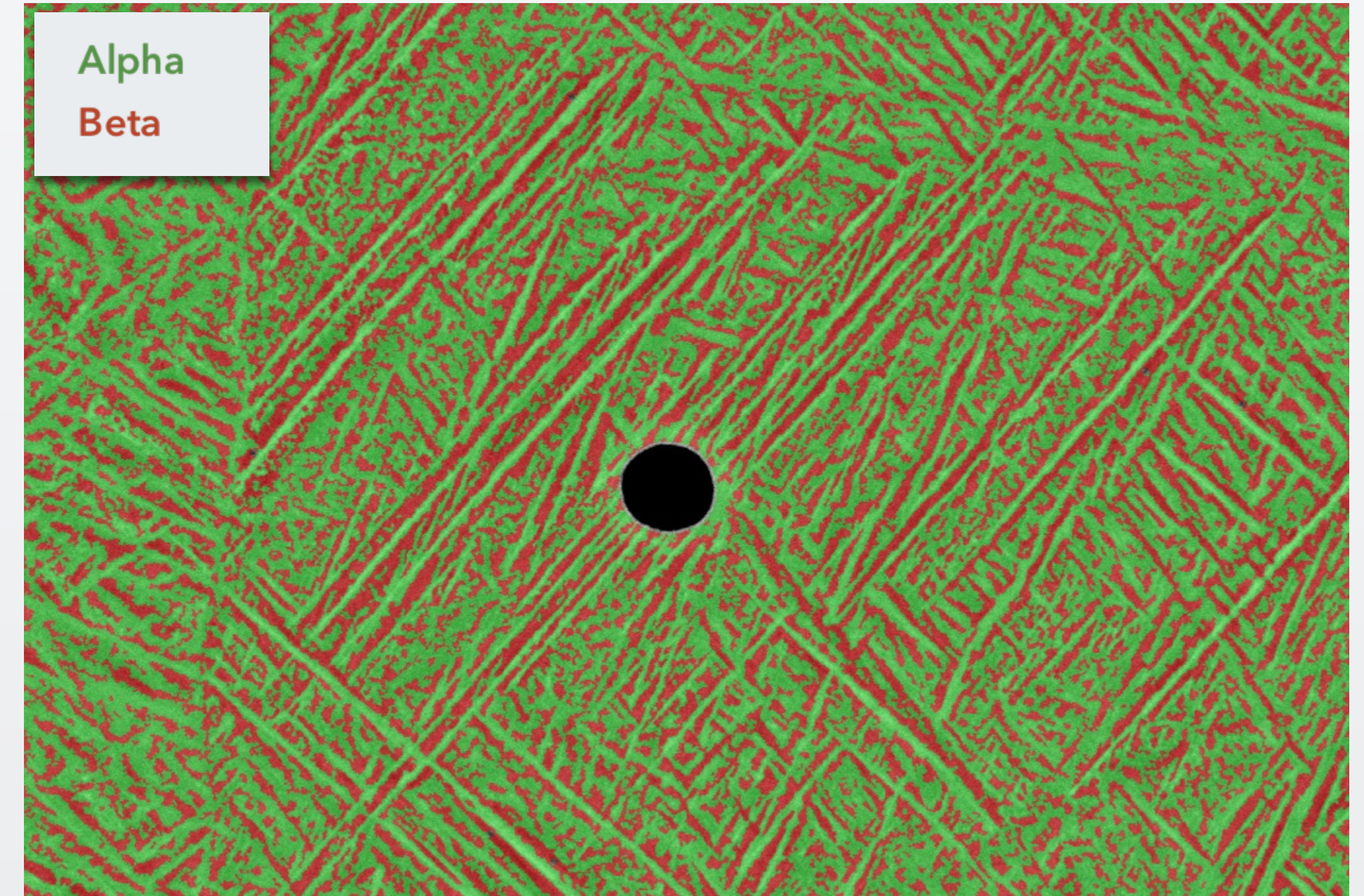
- ✓ Area fraction can be measured
- ✓ Tough to distinguish particles segmented
- ✓ Fully automated workflow

Phase Analysis – Alpha and Beta in Titanium

Original



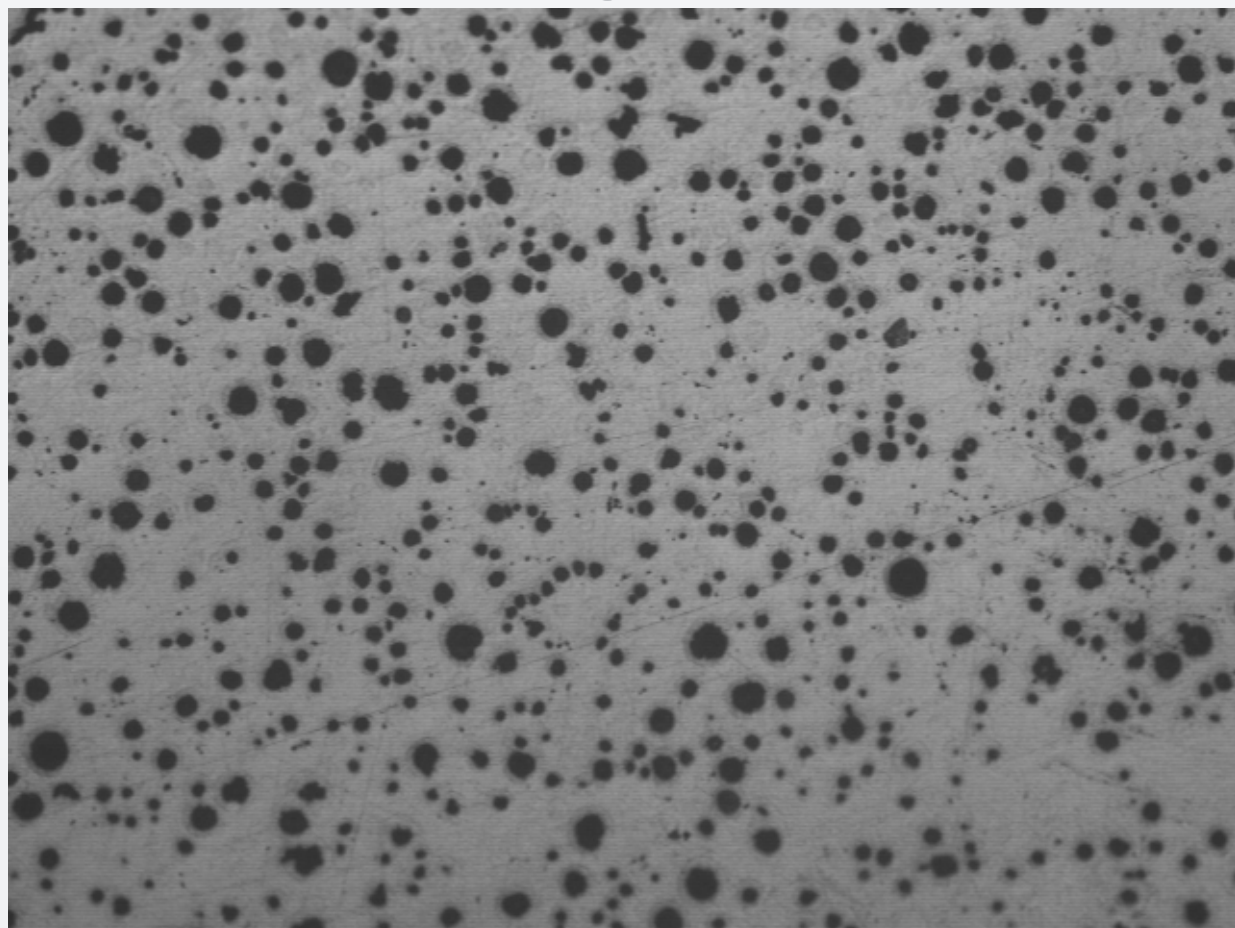
Phase Detection



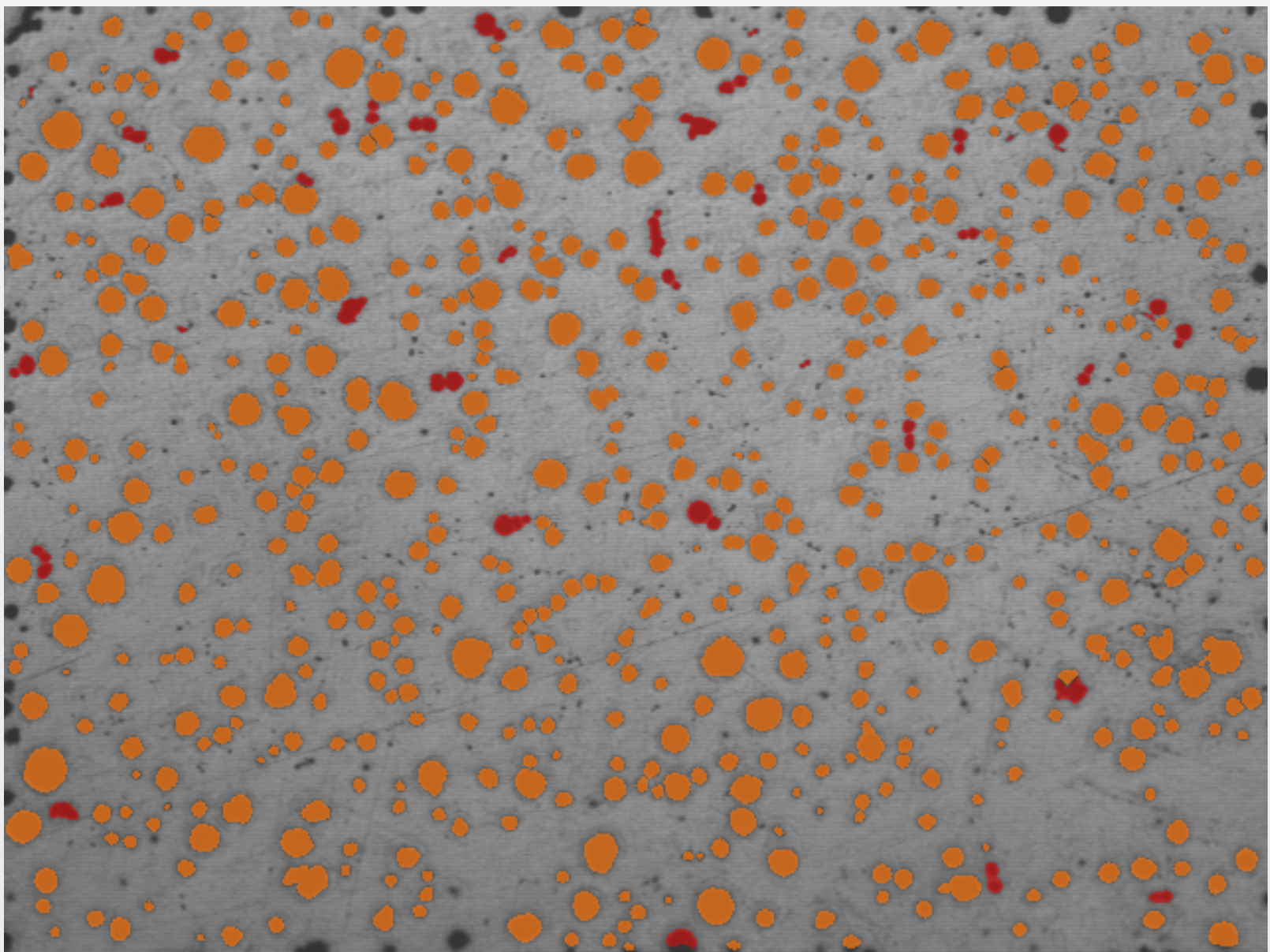
- ✓ Phase fraction can be measured
- ✓ Complex alpha and beta phases detected
- ✓ Robust recipe ignores pores and defects

Steel Inclusions

Original



Identified and Classified



Non-nodular Graphite
Nodular Graphite



Measurements meet ASTM-A247 graphite characterization in steel guidelines



Tailored recipes to internal standards

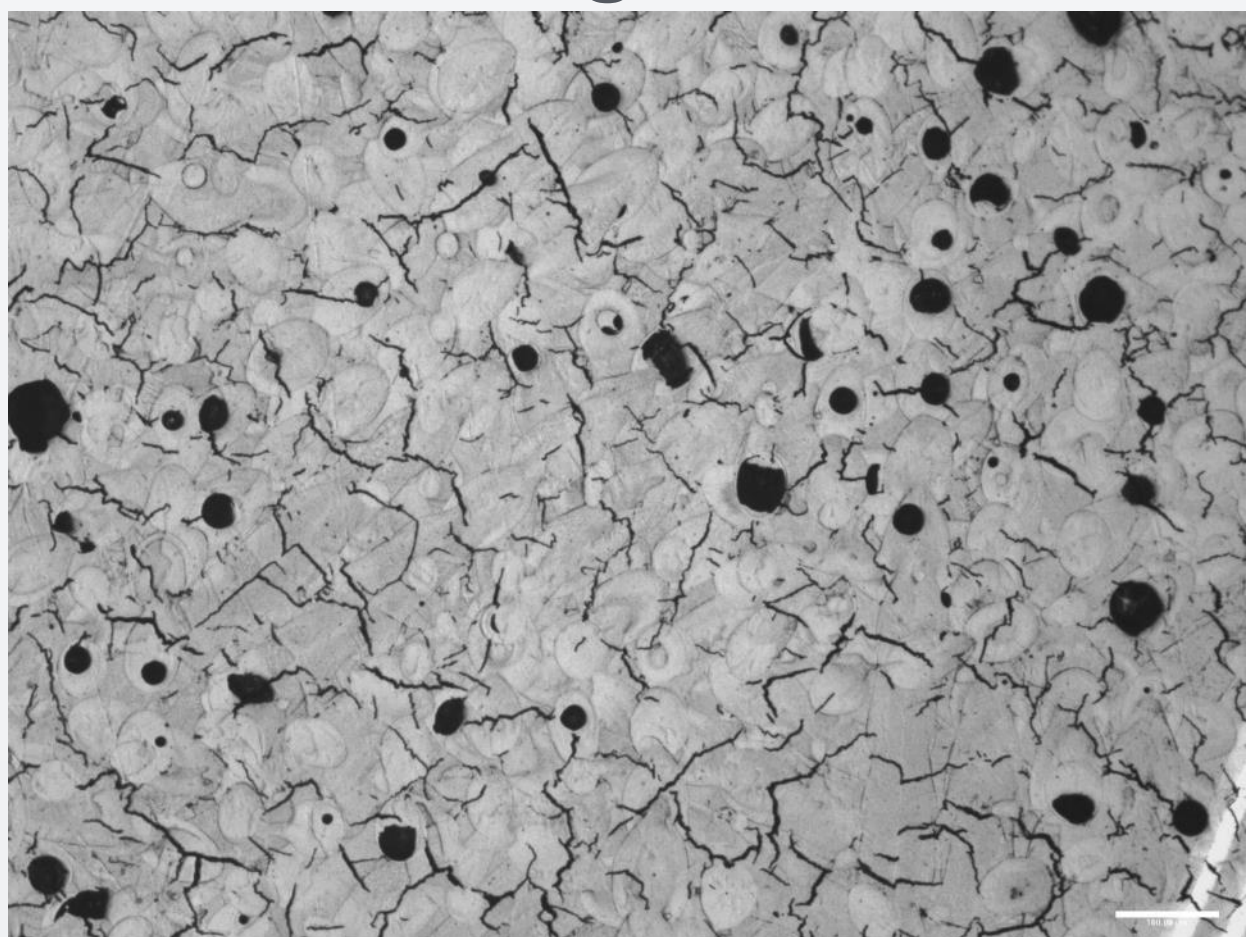


Nodularity Measurement

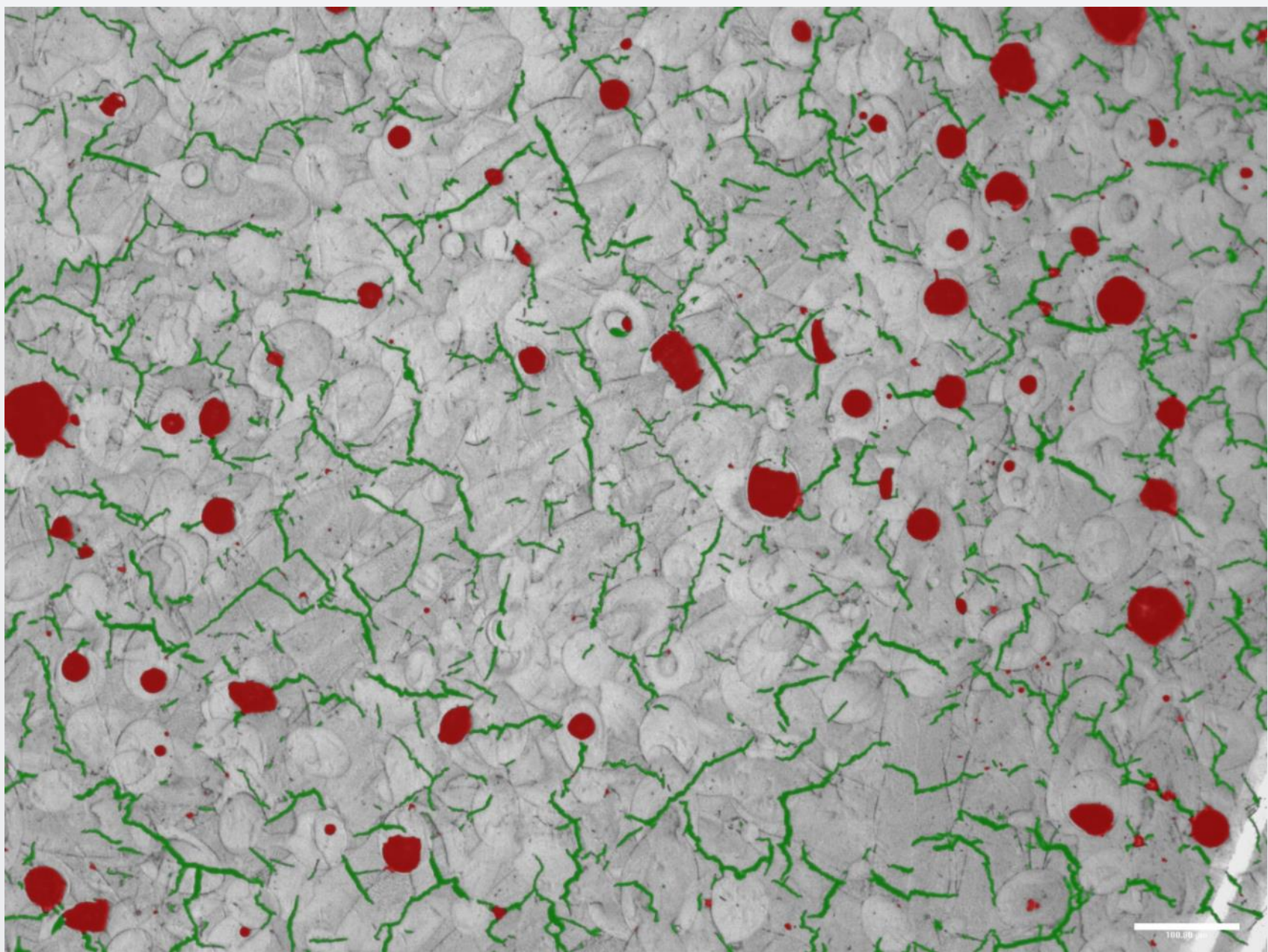
Measurements		
	Layer	Area Fraction (%)
	ASTM Nodularity Percentage	94.4780

Defects Analysis – Additive Manufacturing

Original



Identified and Classified



Pores
Cracks



Calibrate recipe to match existing techniques



Facilitates workflow integration



Crack + Pore Measurement

Measurements			
	Layer	Area Fraction (%)	Number Density (features/ μm^2)
	Pores	3.7940	1.4408e-04
	Cracks	5.9420	9.5184e-04

Layer Thickness Analysis – Grain-Band Identification

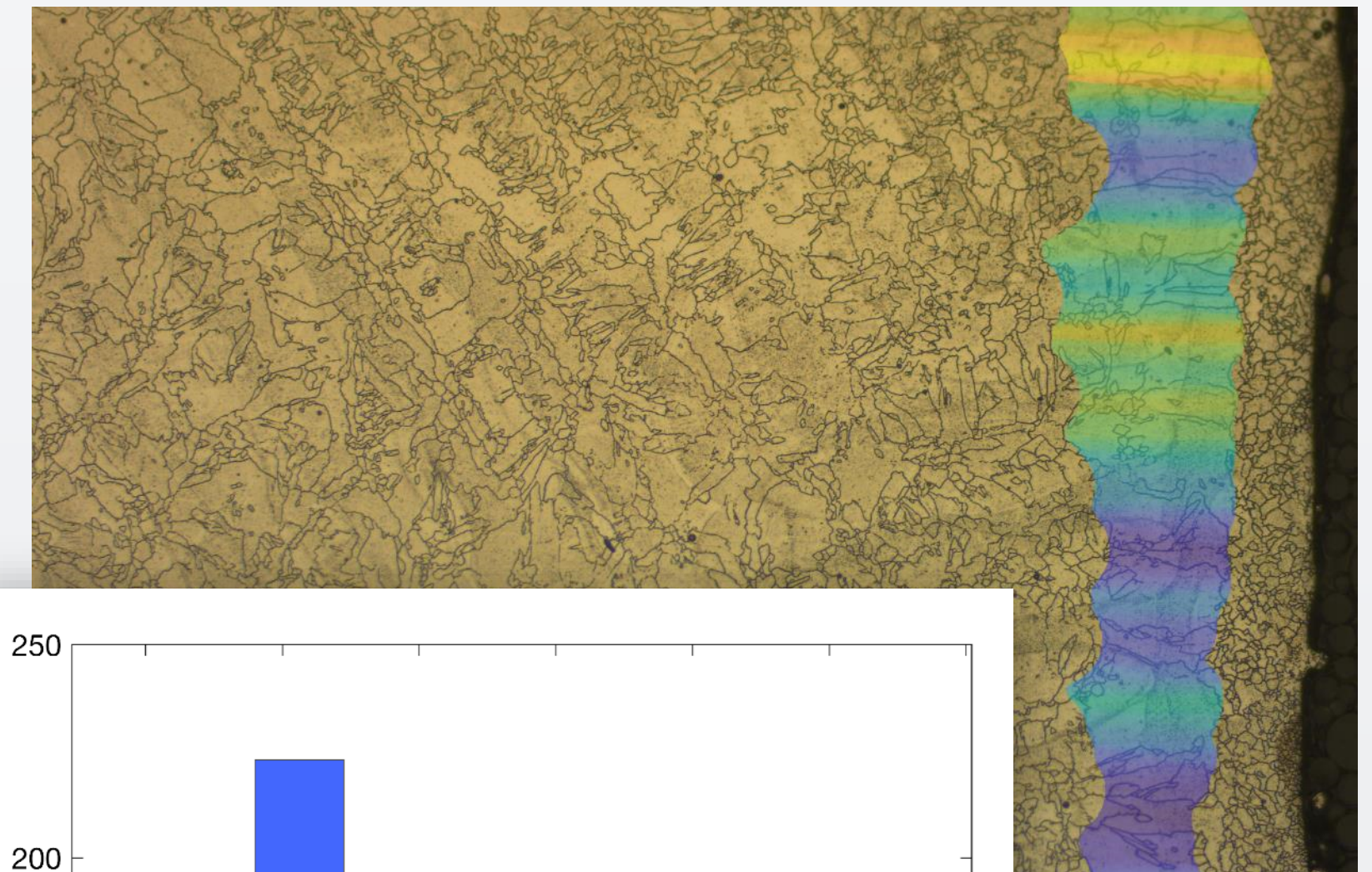
Original



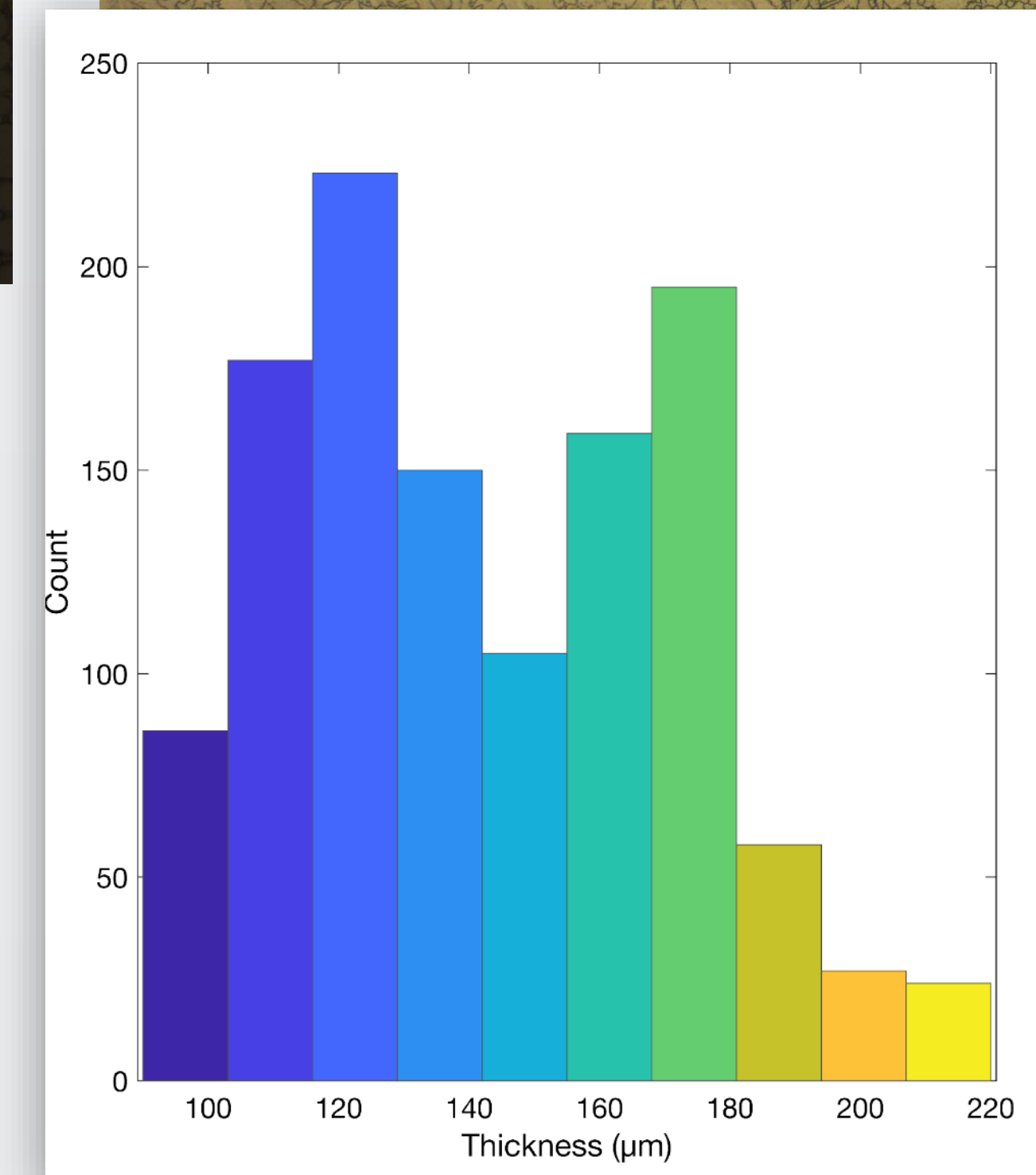
Grain-Band Identification



Thickness Measurement

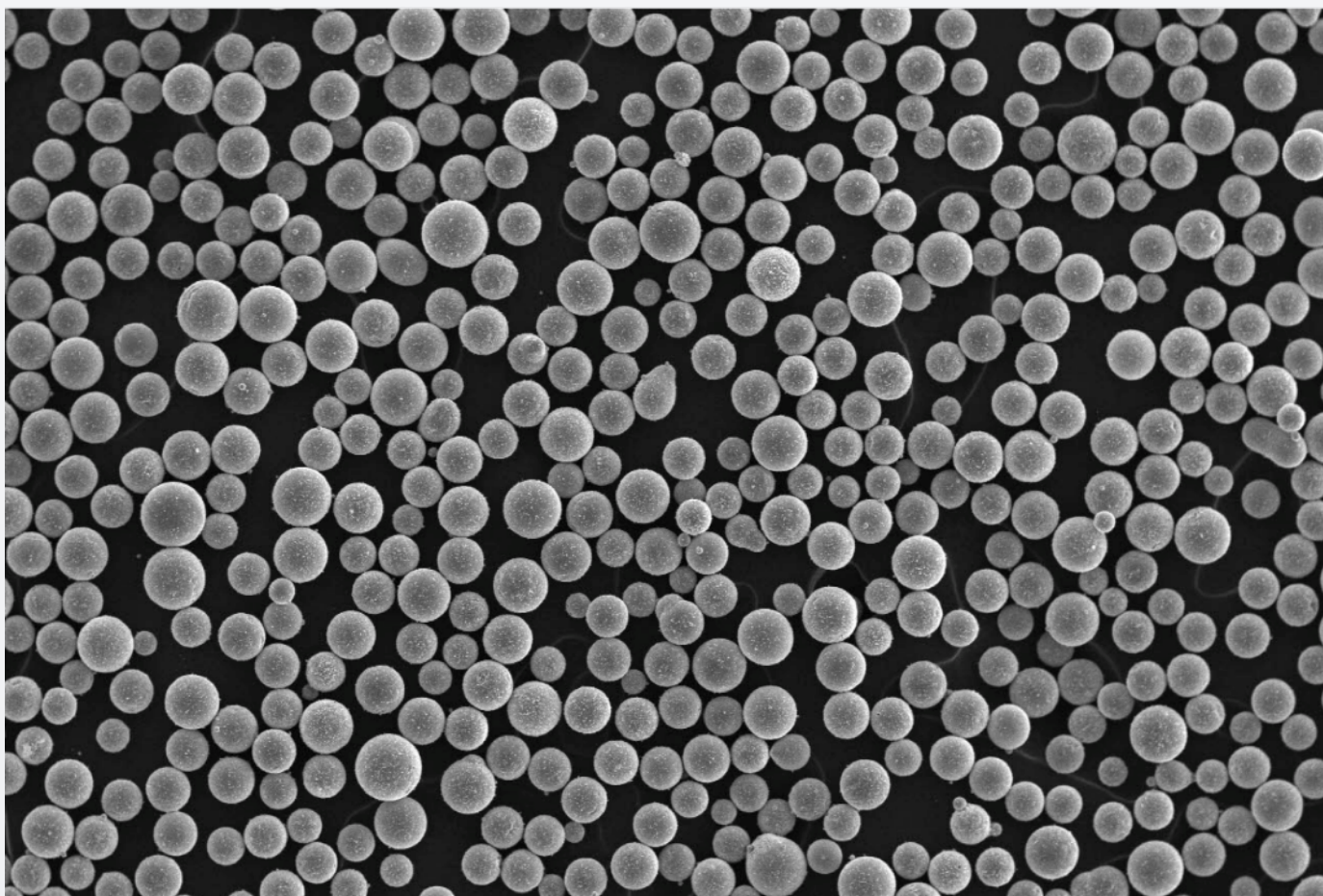


Band widths can be measured

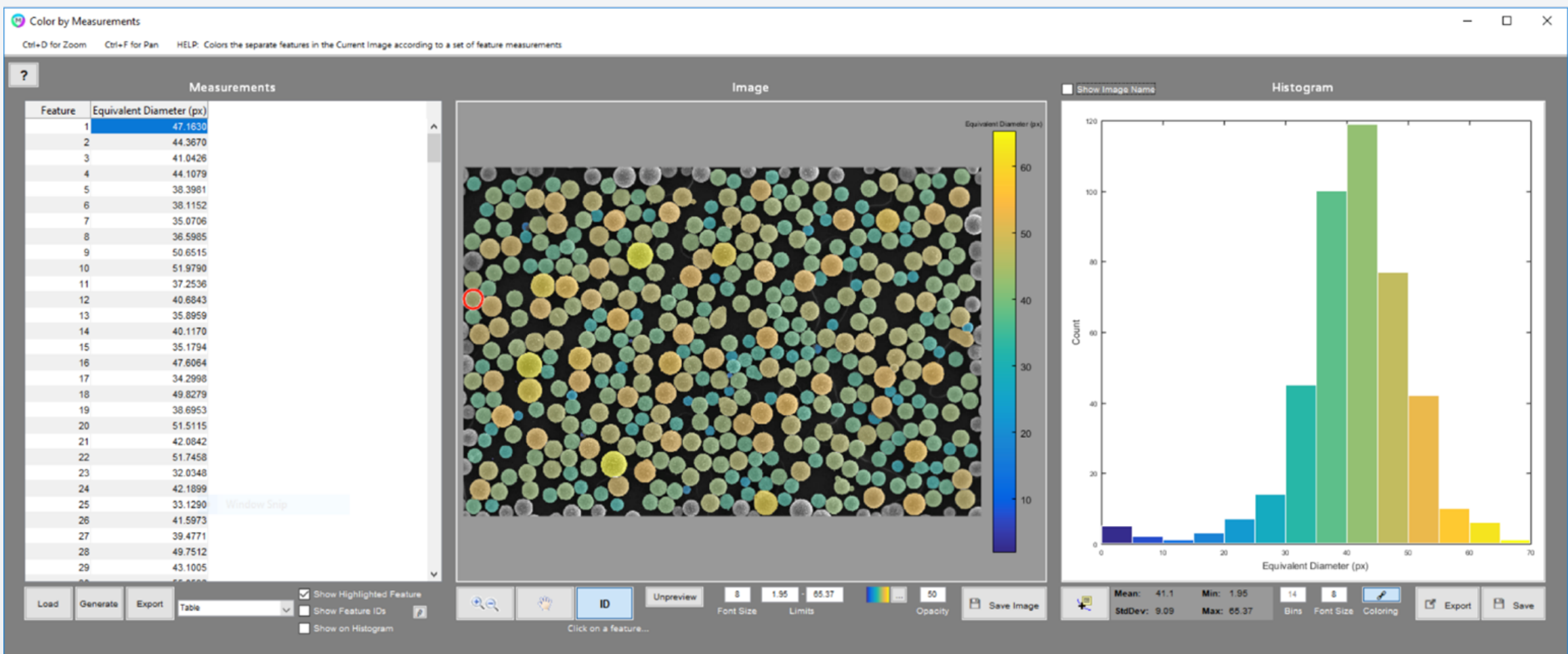


Powder particles – Size and Shape Measurements

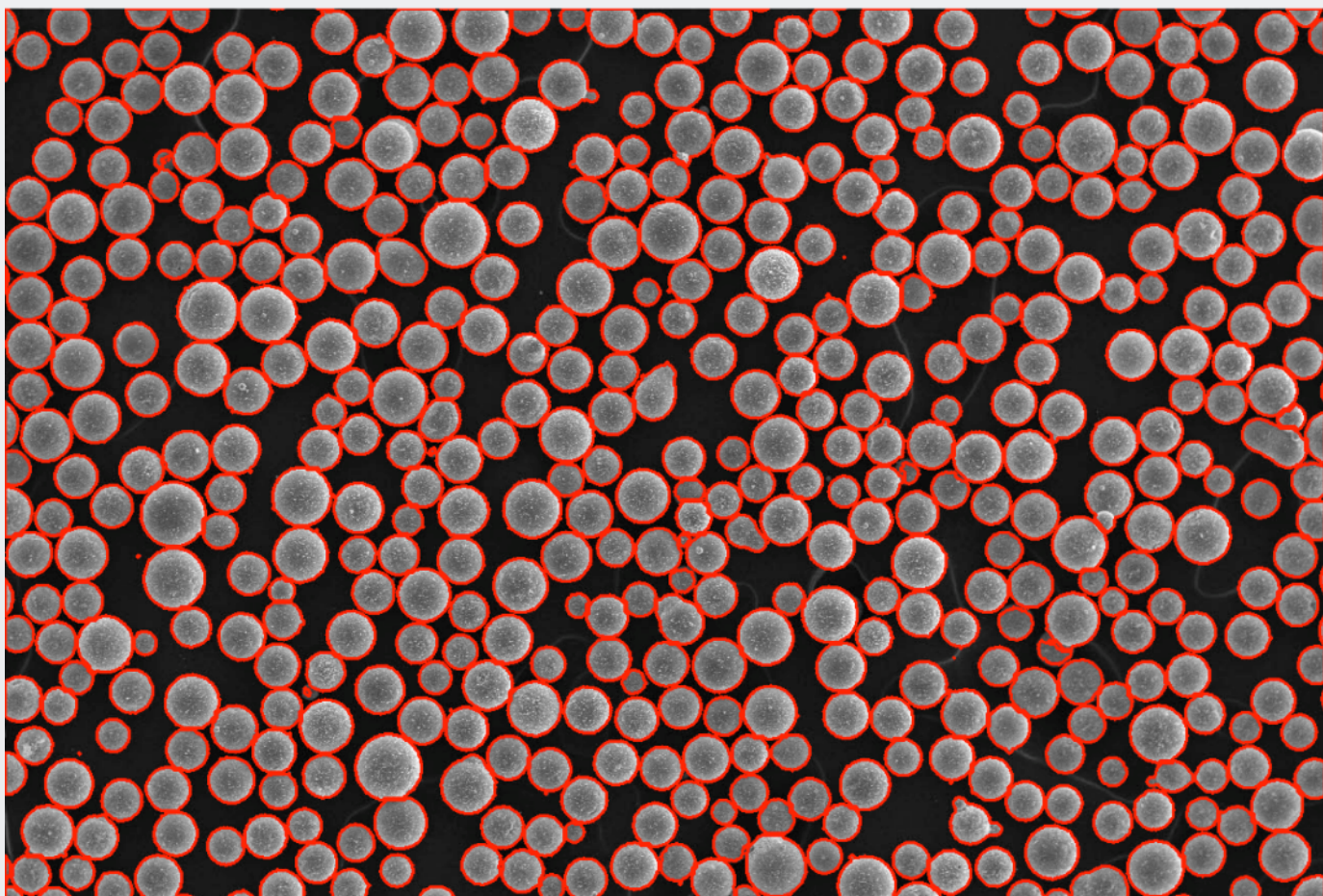
Original



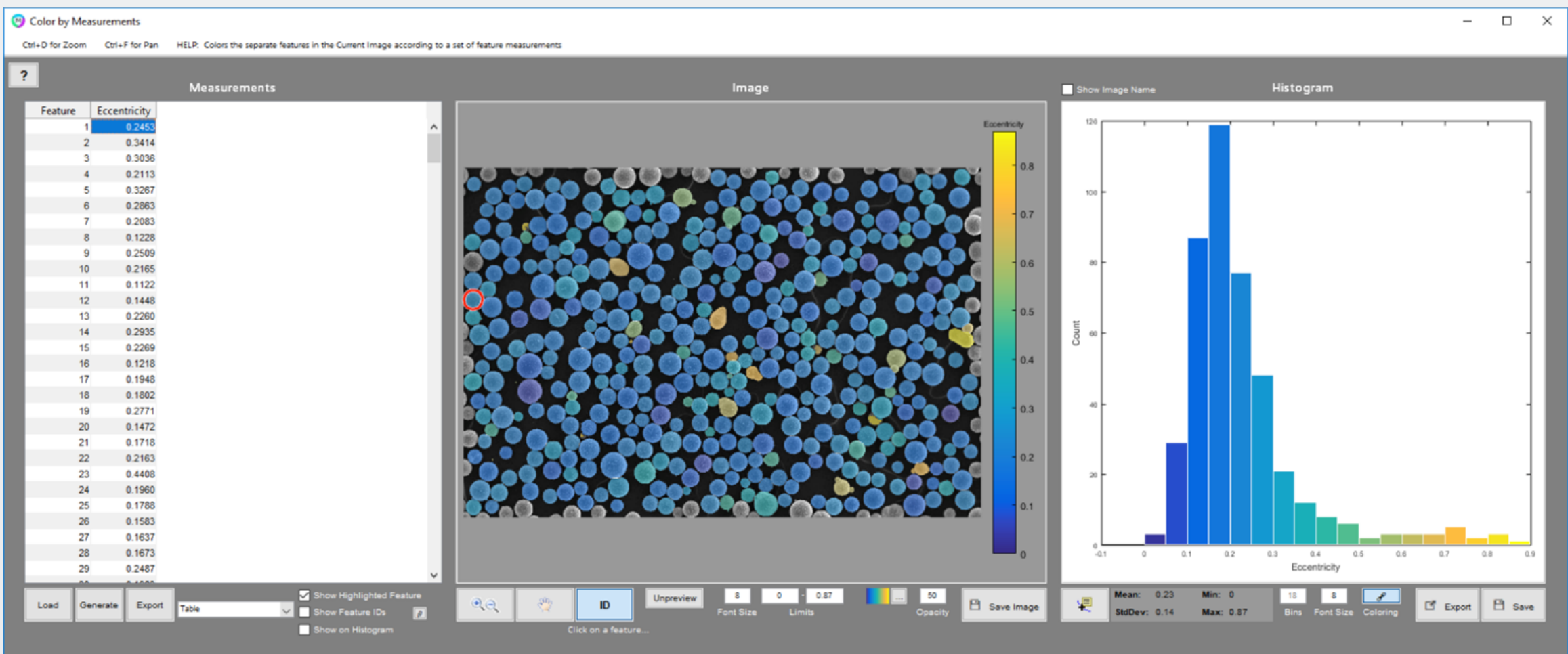
Size Measurement



Identified Particles



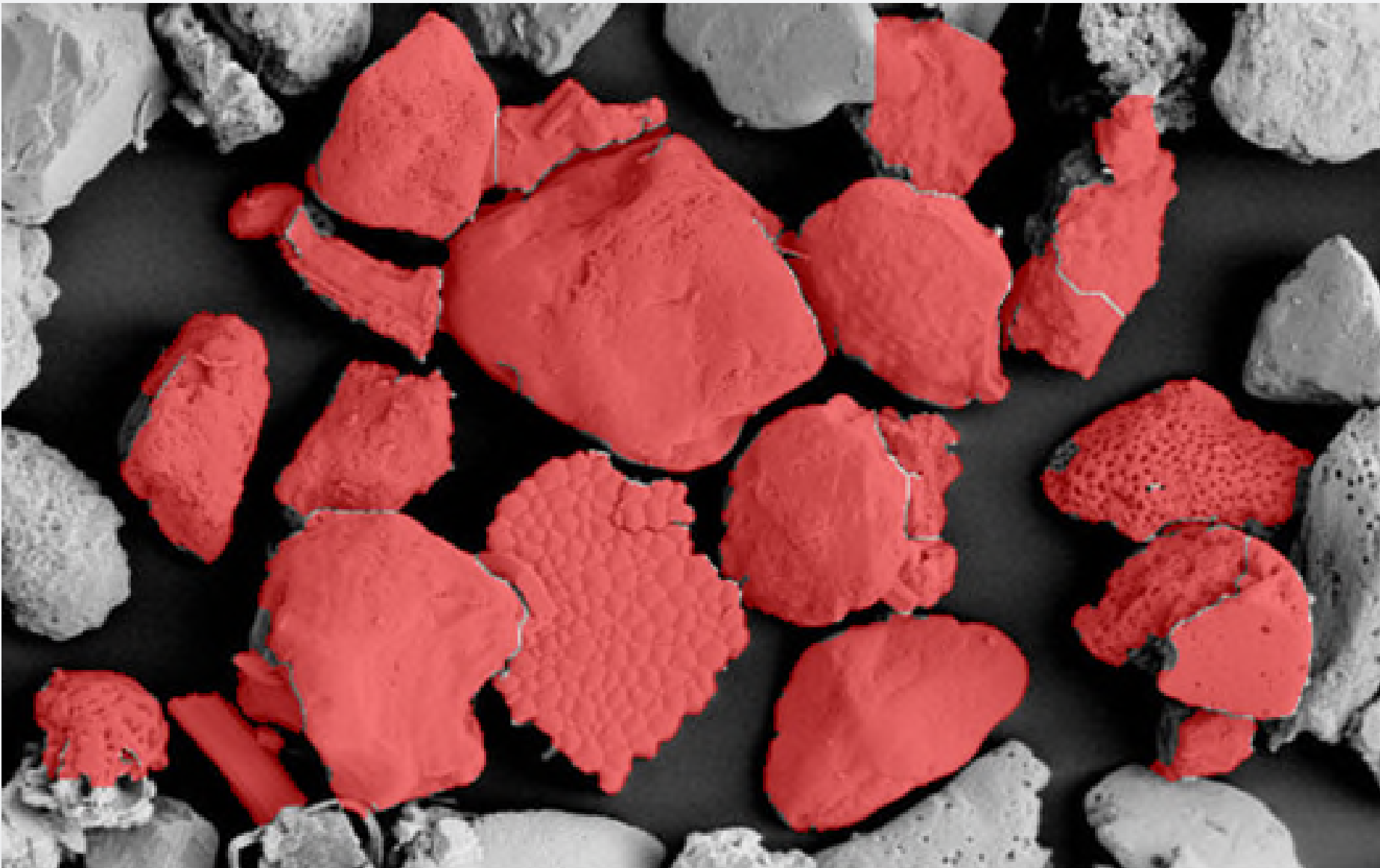
Shape Measurement



SEM Image of Particles is Segmented and Characterized by Size (Diameter) and Shape (Eccentricity)

Particles – Shape Analysis

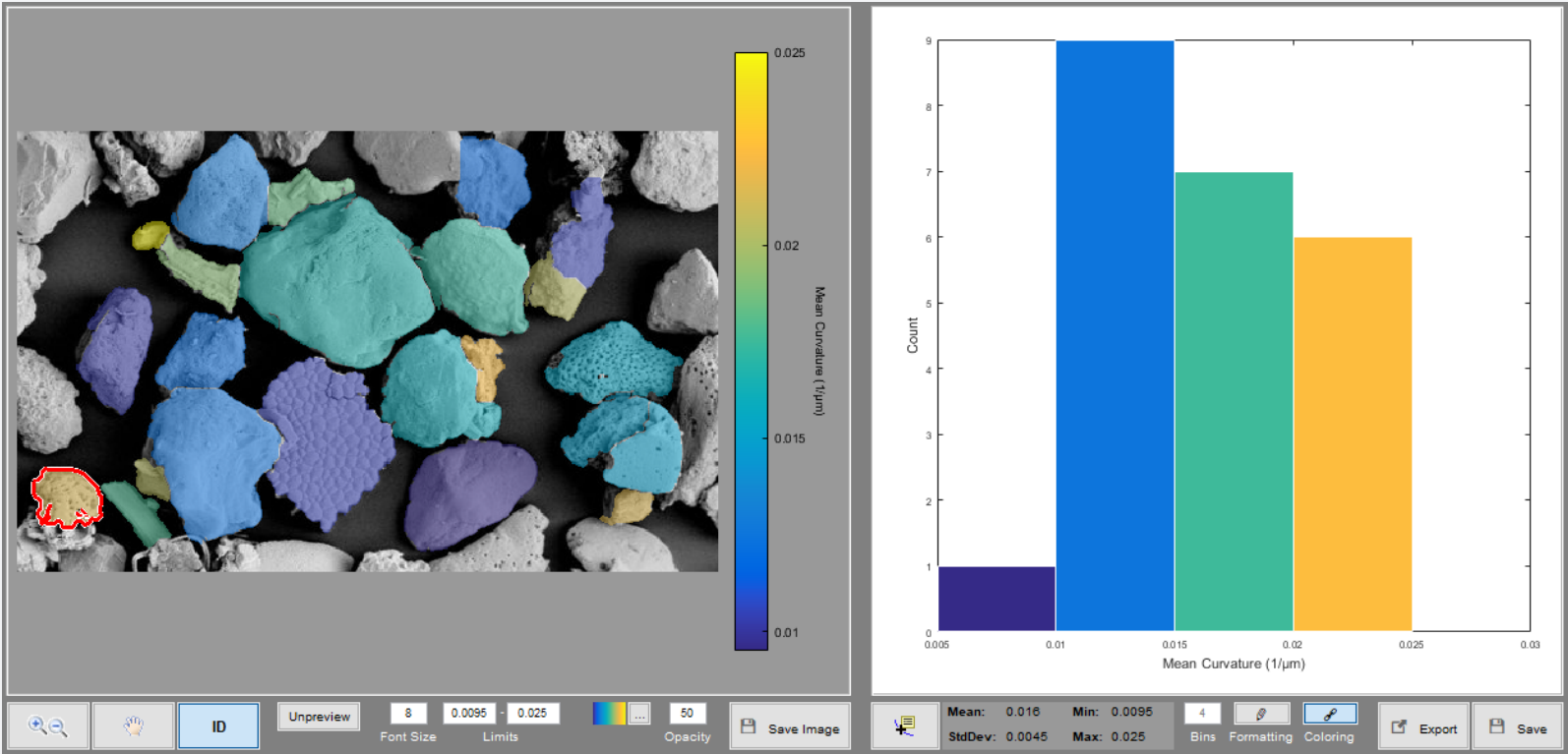
Identified Particles



Feature Shape Measurement

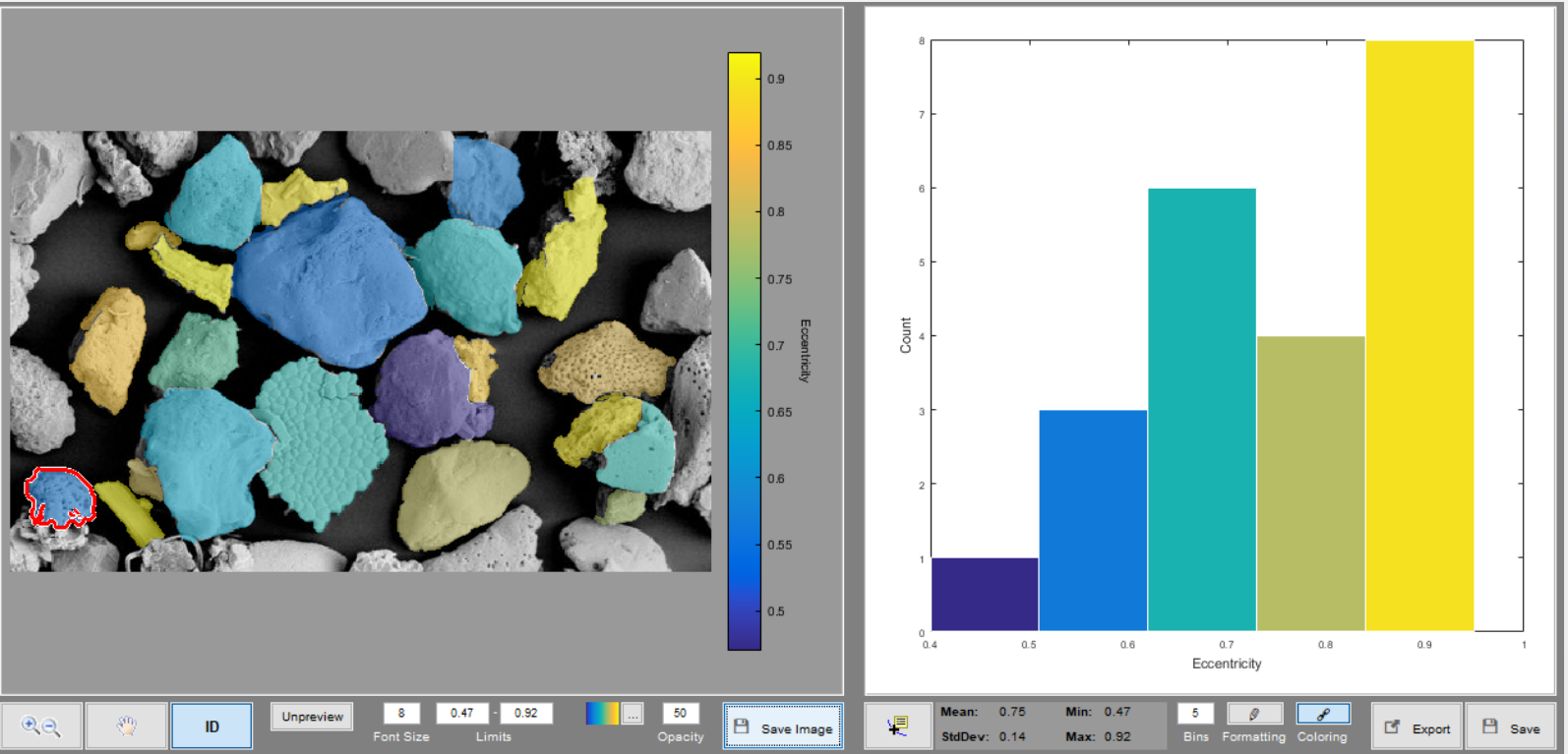
Curvature

Mean Local Curvature
Dark – Concave Surface Features
Light – Convex Surface Features



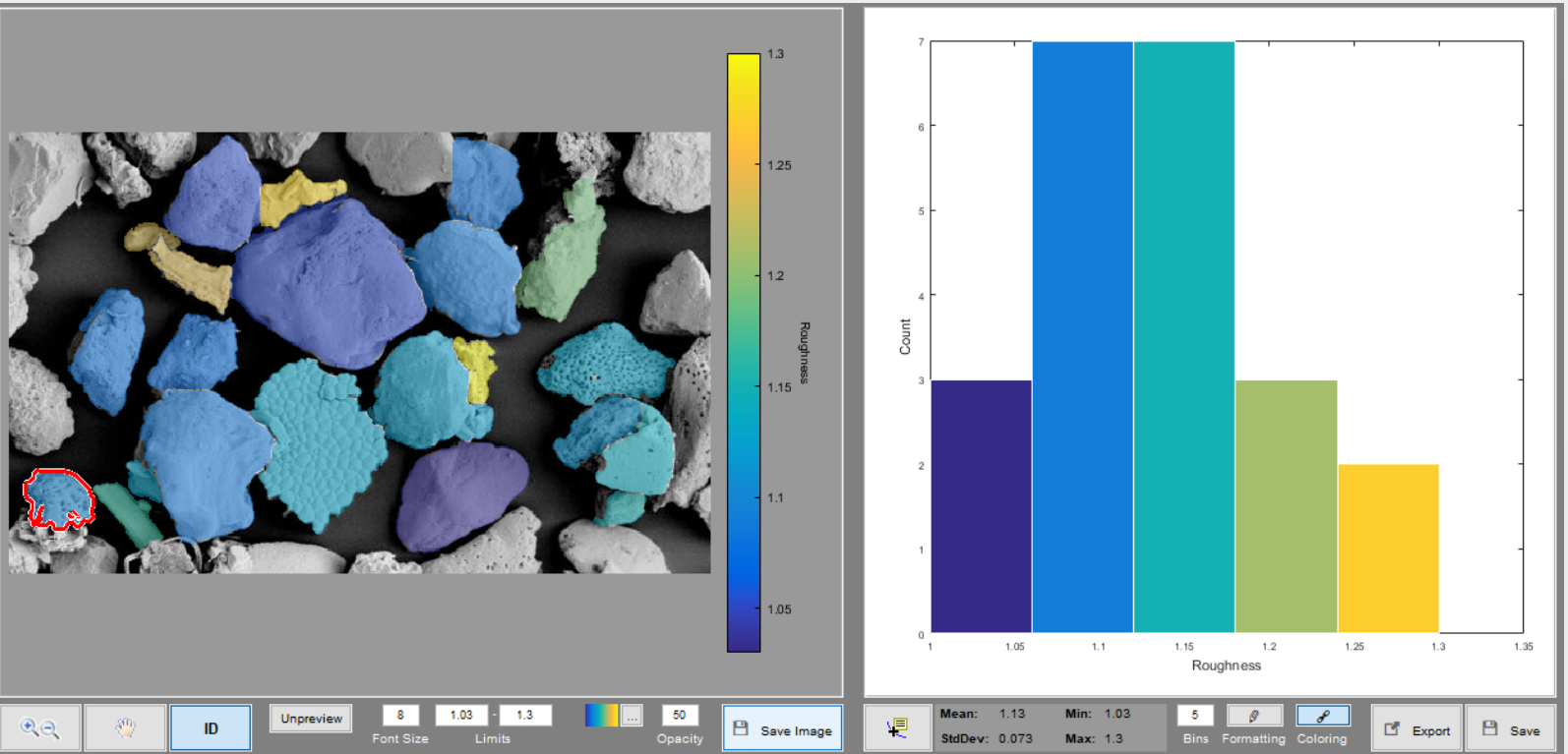
Eccentricity

Feature Eccentricity
Dark – Round
Light – Elongated



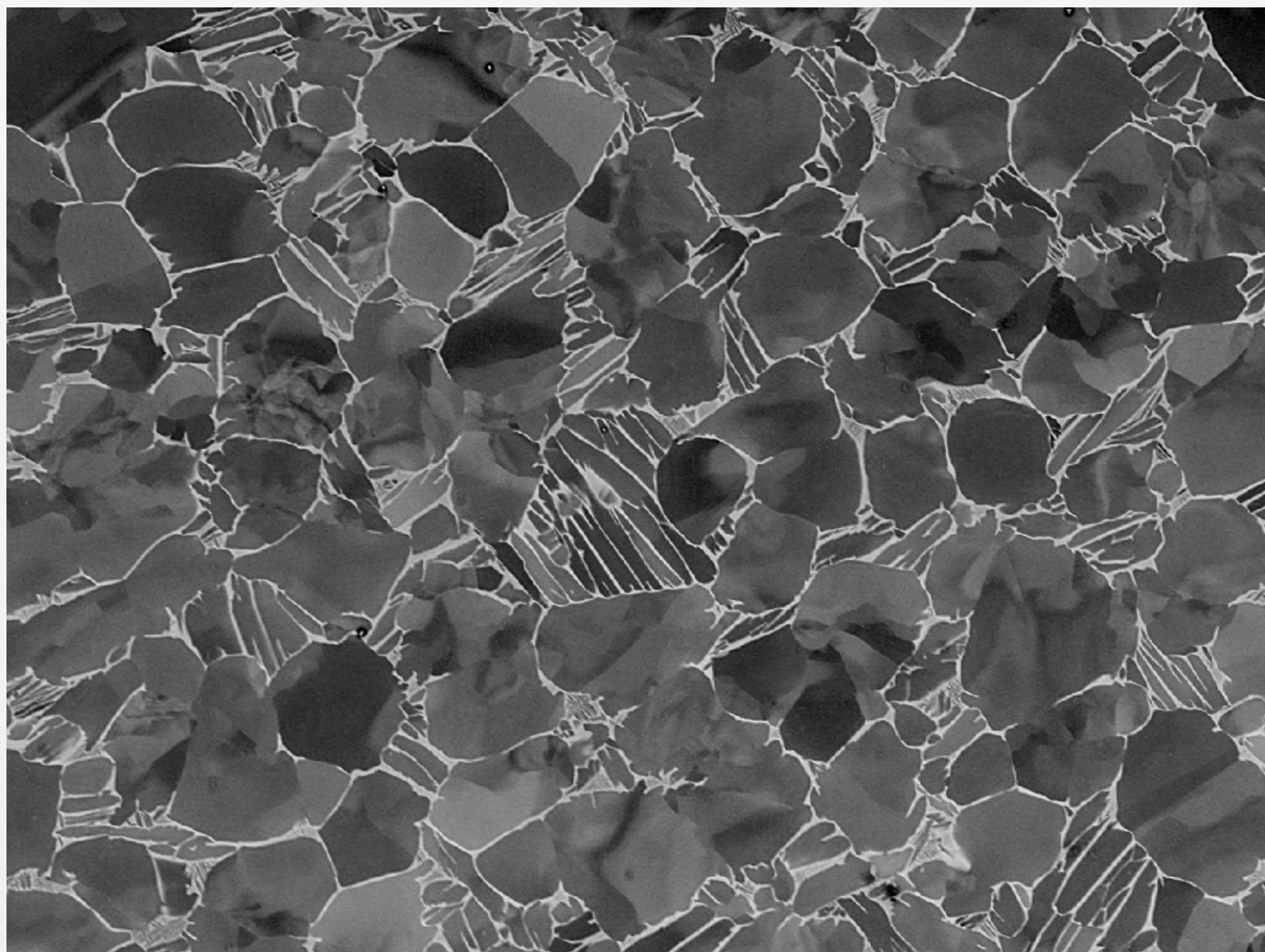
Roughness

Feature Roughness
Dark – Low Surface Variation
Light – High Surface Variation



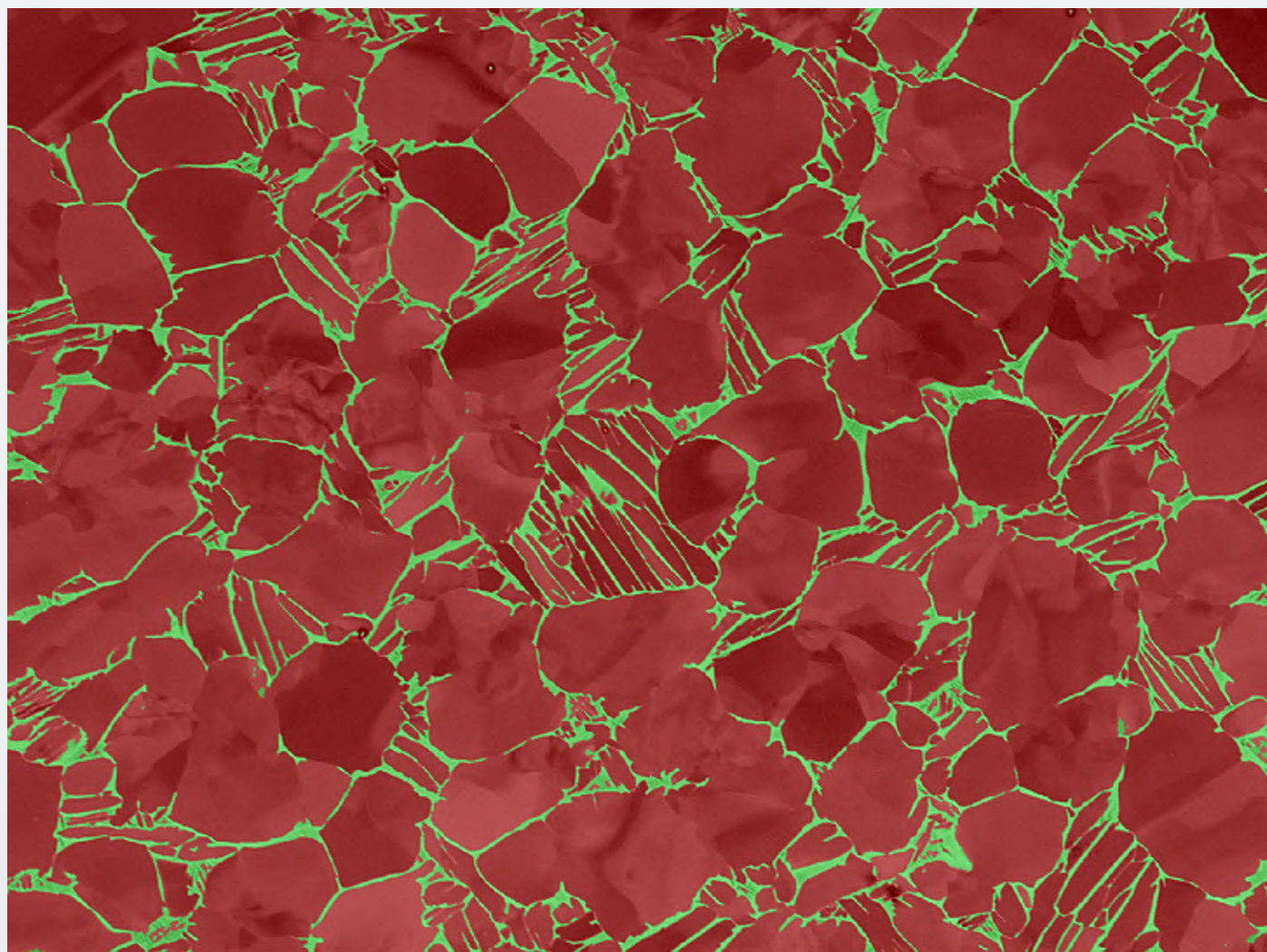
Advanced Characterization – Titanium

Original



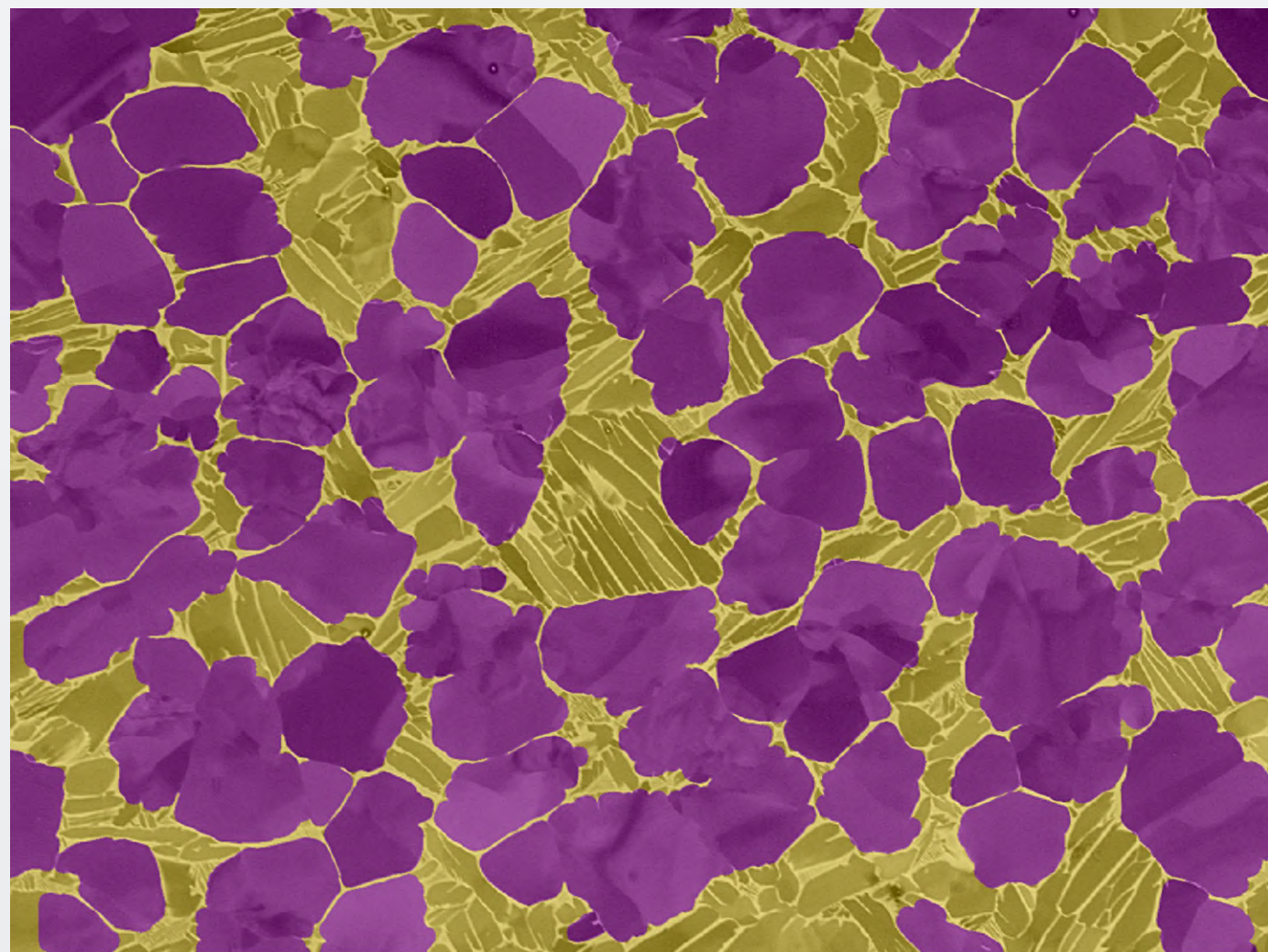
Automated and accurate characterization of complex microstructures

Phase Segmentation



+

Morphology Segmentation



Alpha



Volume Fraction

Beta



Volume Fraction

Particles



Volume Fraction
Mean Diameter

Laths

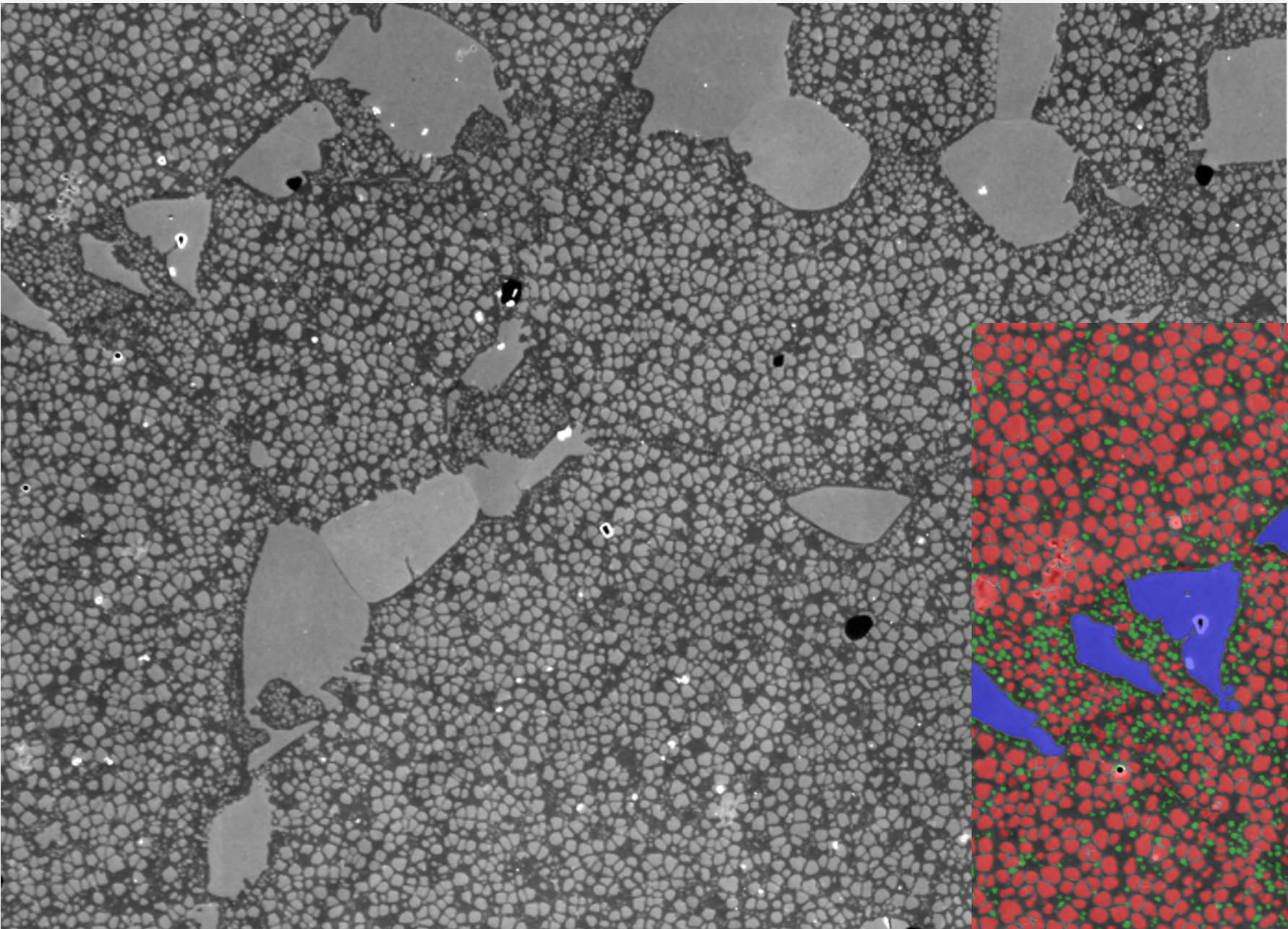


Mean Thickness

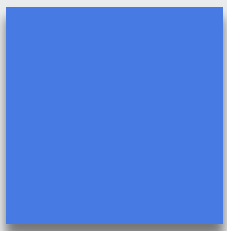
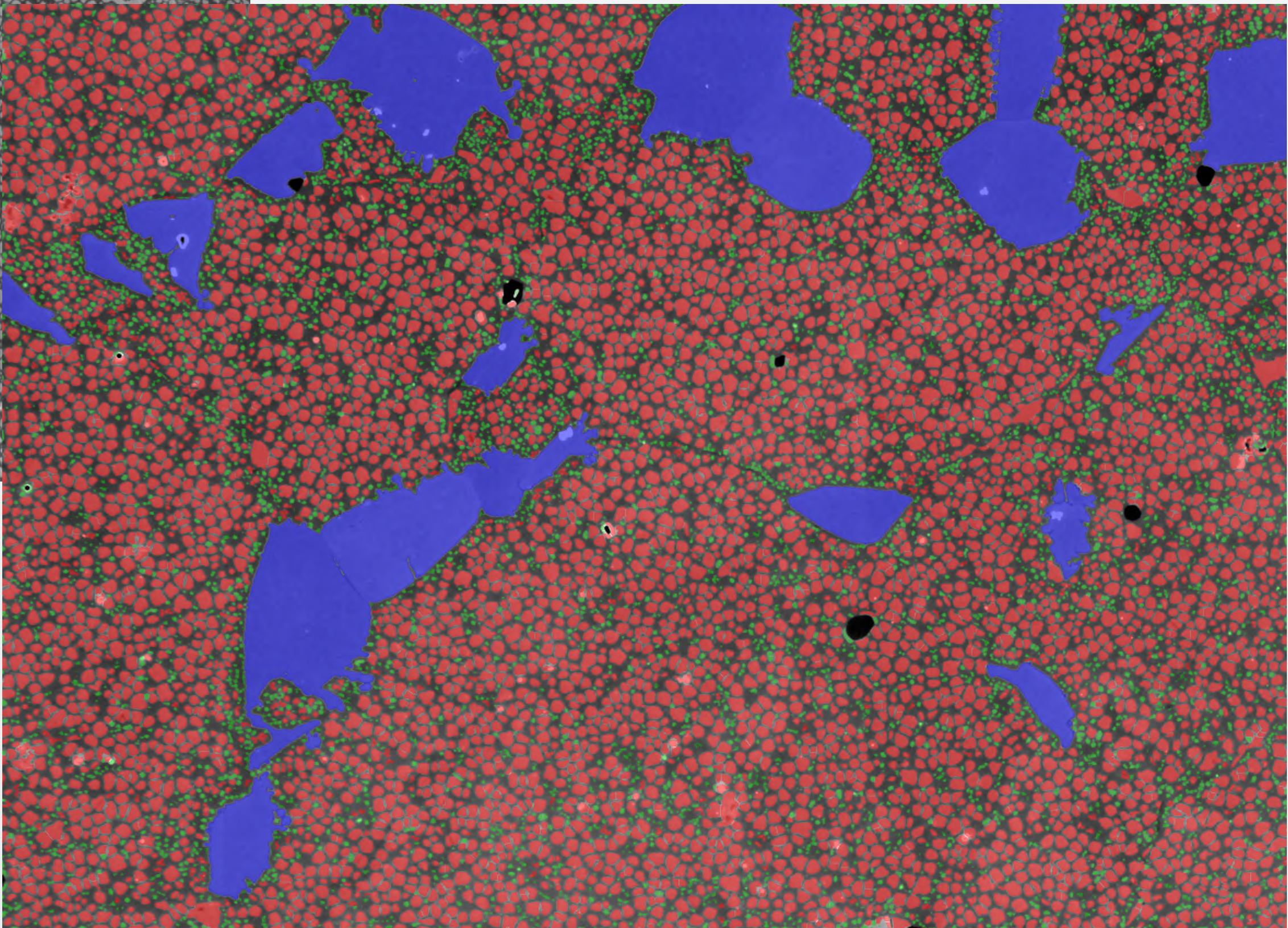
Measurements

Advanced Characterization – Nickel-Base Superalloys

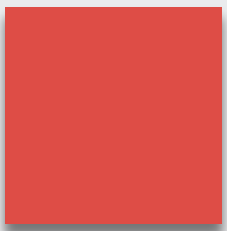
Subsolvus Microstructure



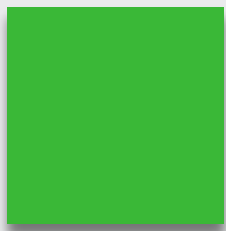
Classified Particles



Primary



Secondary



Tertiary



All three modes captured in one field-of-view



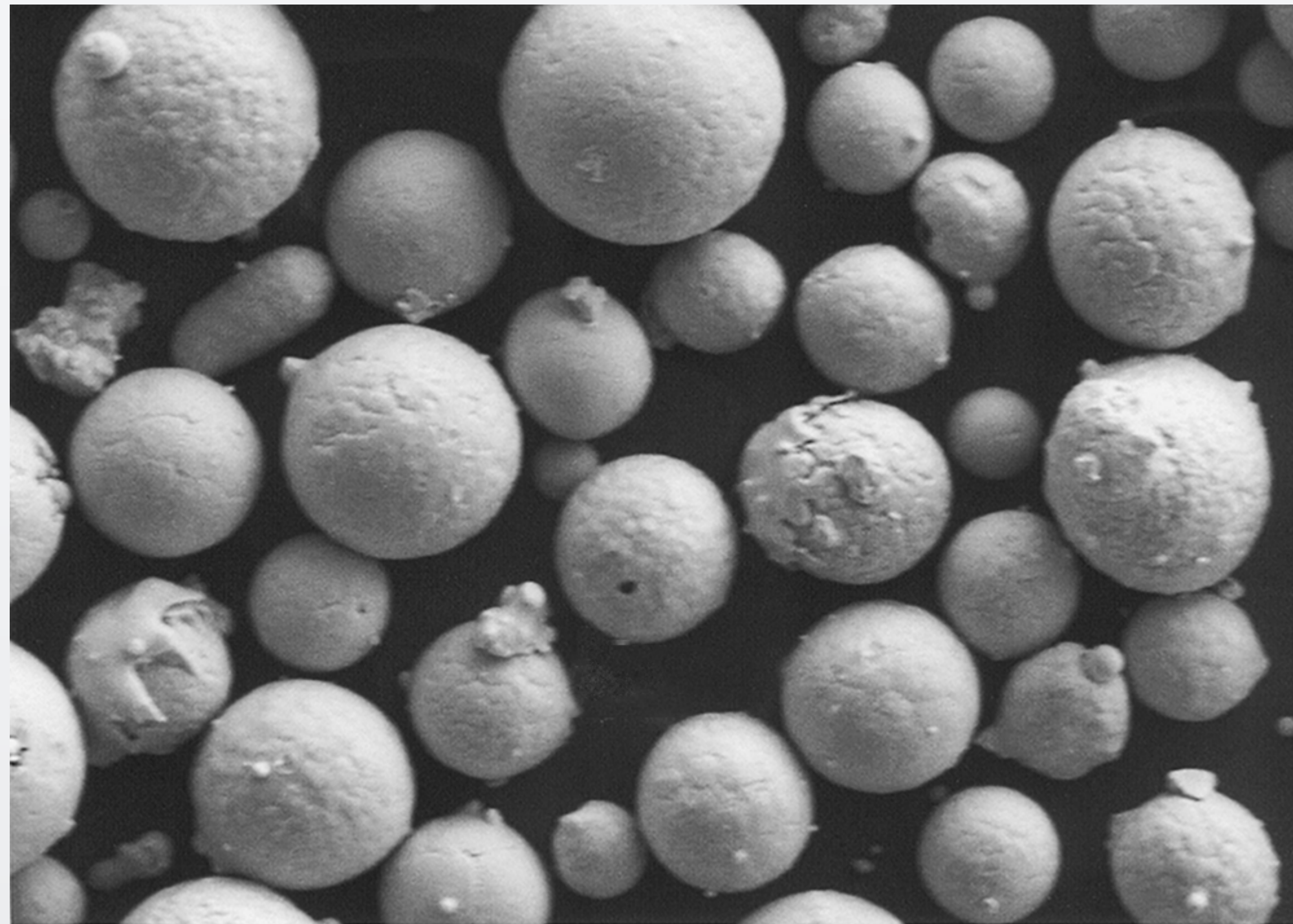
Set to become the new standard in gamma prime characterization



	Volume Fraction (%)
Primary	12.3
Secondary	35.8
Tertiary	5.1
TOTAL	53.2

Powder particles – Satellite Analysis

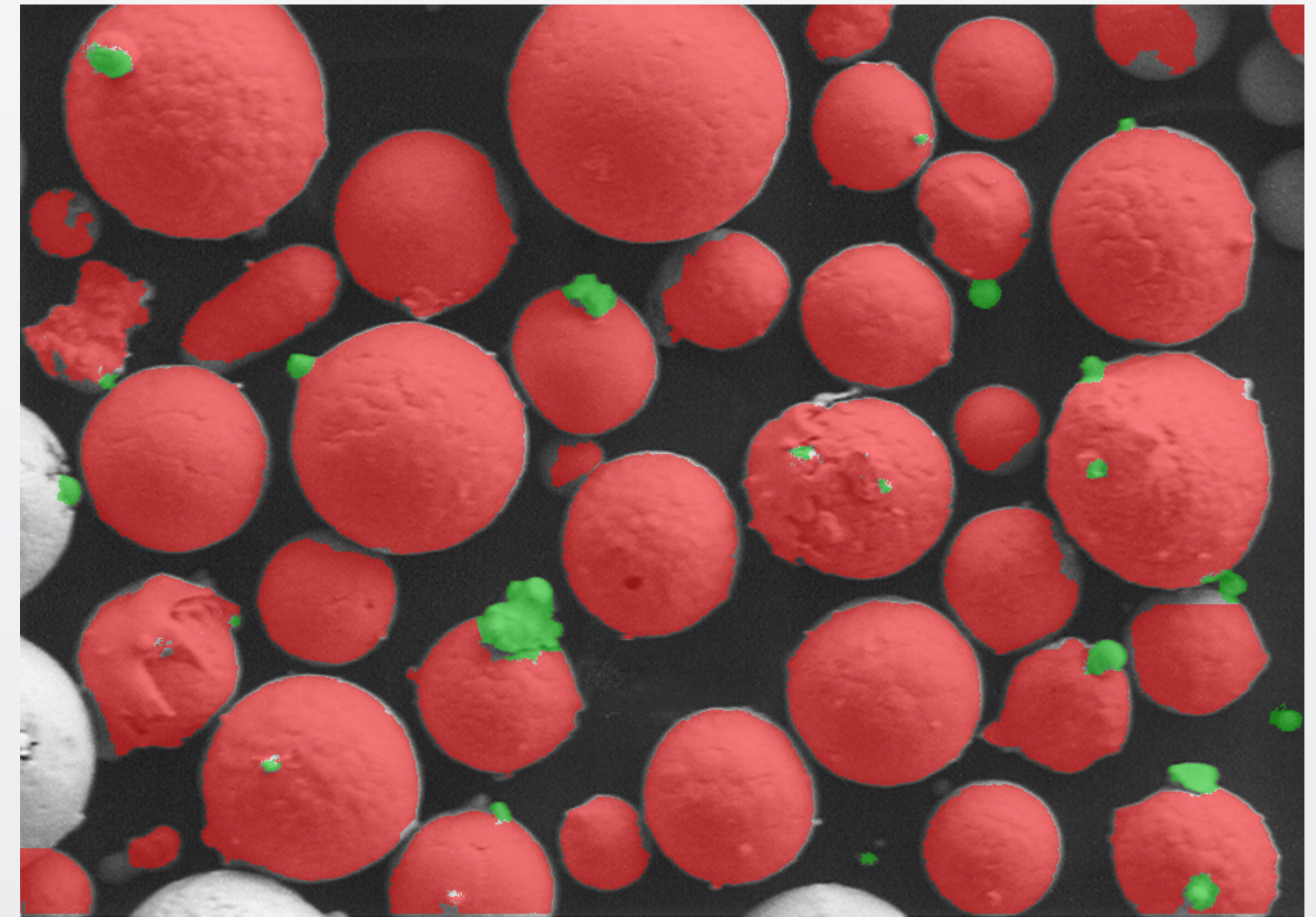
Original



© ASM International®
ti0278

45 µm

**Particle
detection**



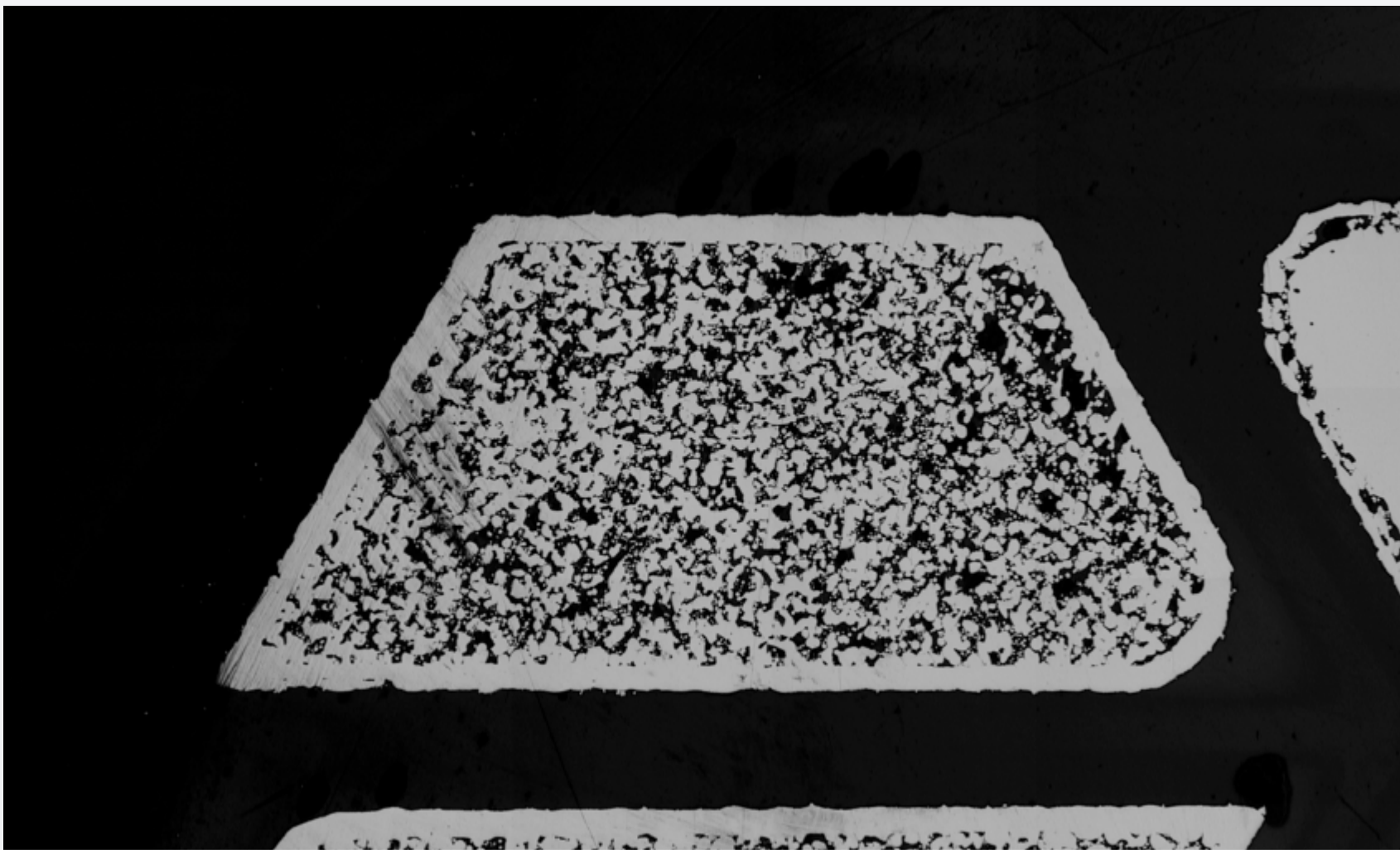
© ASM International®
ti0278

45 µm

- ✓ Diameter of particles can be measured
- ✓ Fully automated satellite detection

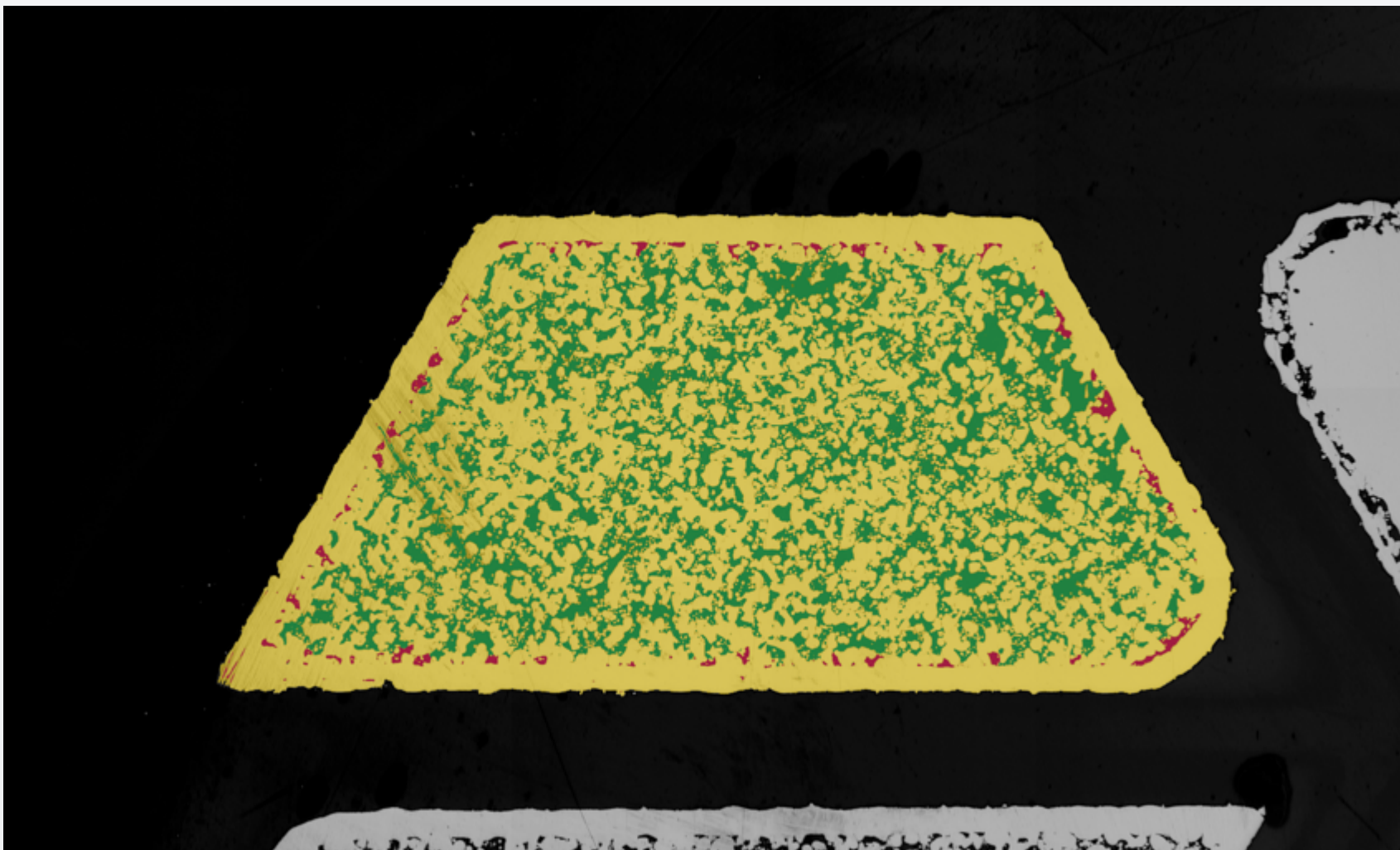
Porosity Analysis – Additive Manufactured Parts

Original

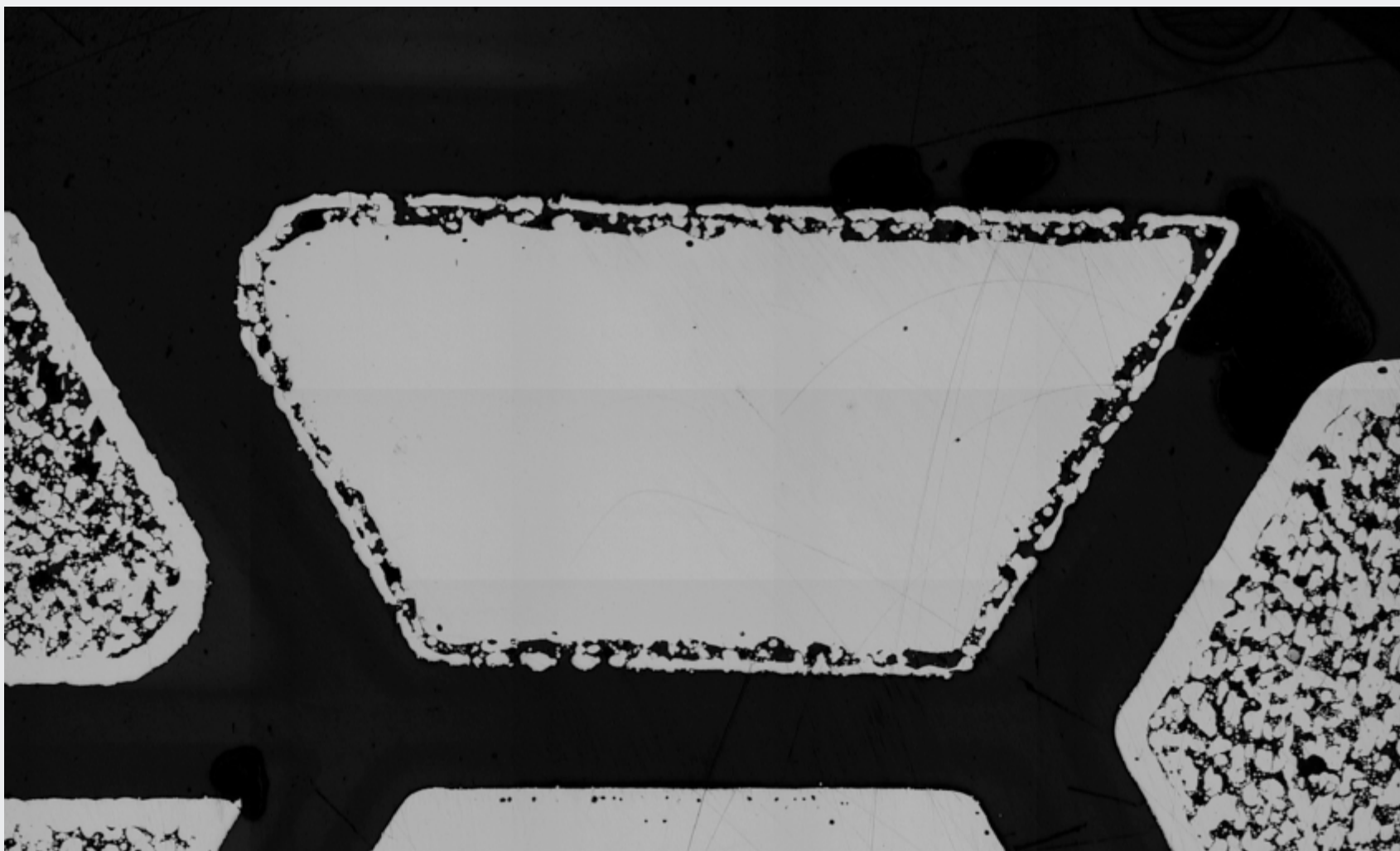


15 sec

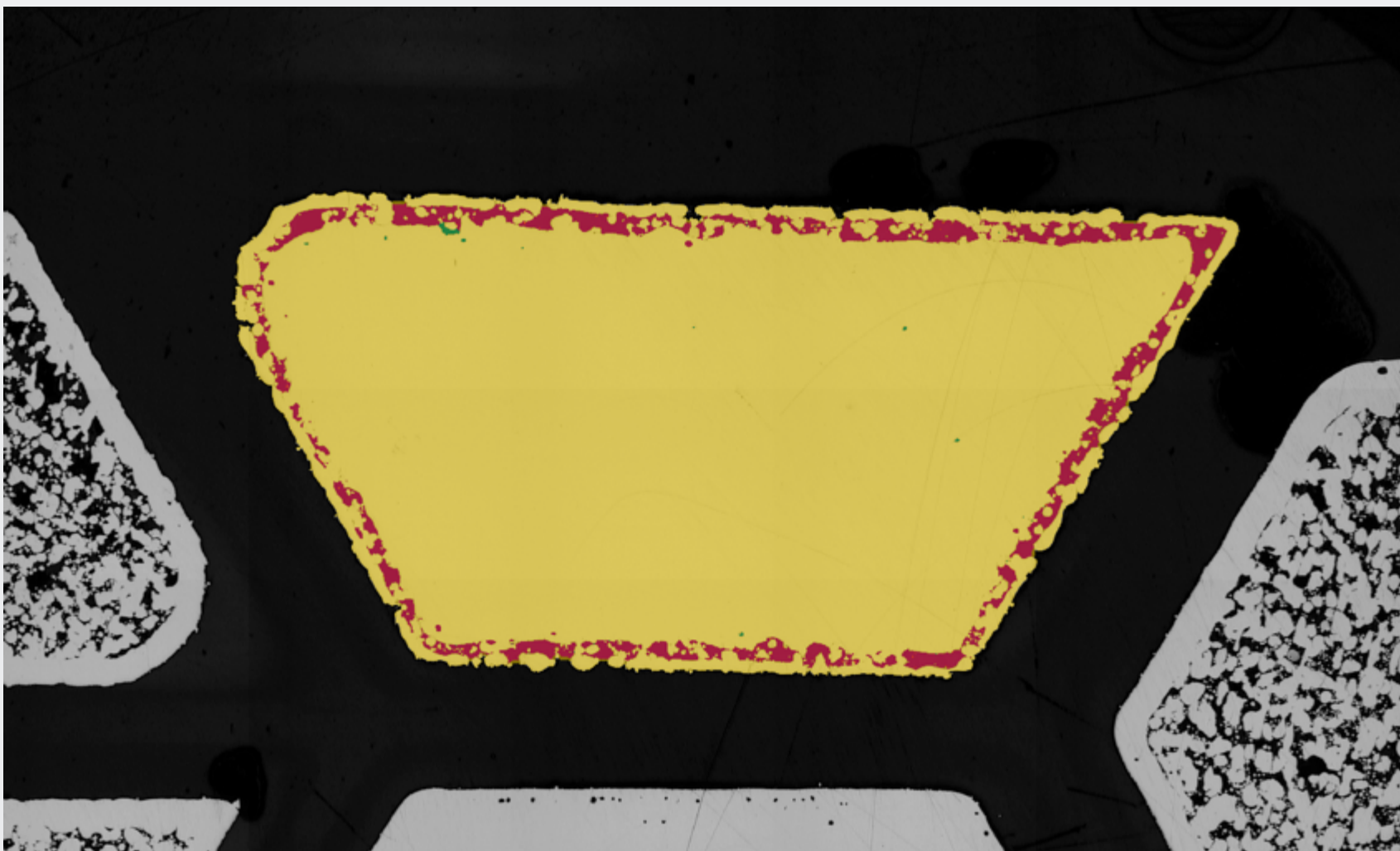
Solid Porosity



	Layer	Area Fraction (%)
	Part	100
	Border Pores	5.6770
	Bulk Pores	31.9670
	All Pores	26.0900



15 sec



	Layer	Area Fraction (%)
	Part	100
	Border Pores	26.3390
	Bulk Pores	0.0742
	All Pores	6.2600



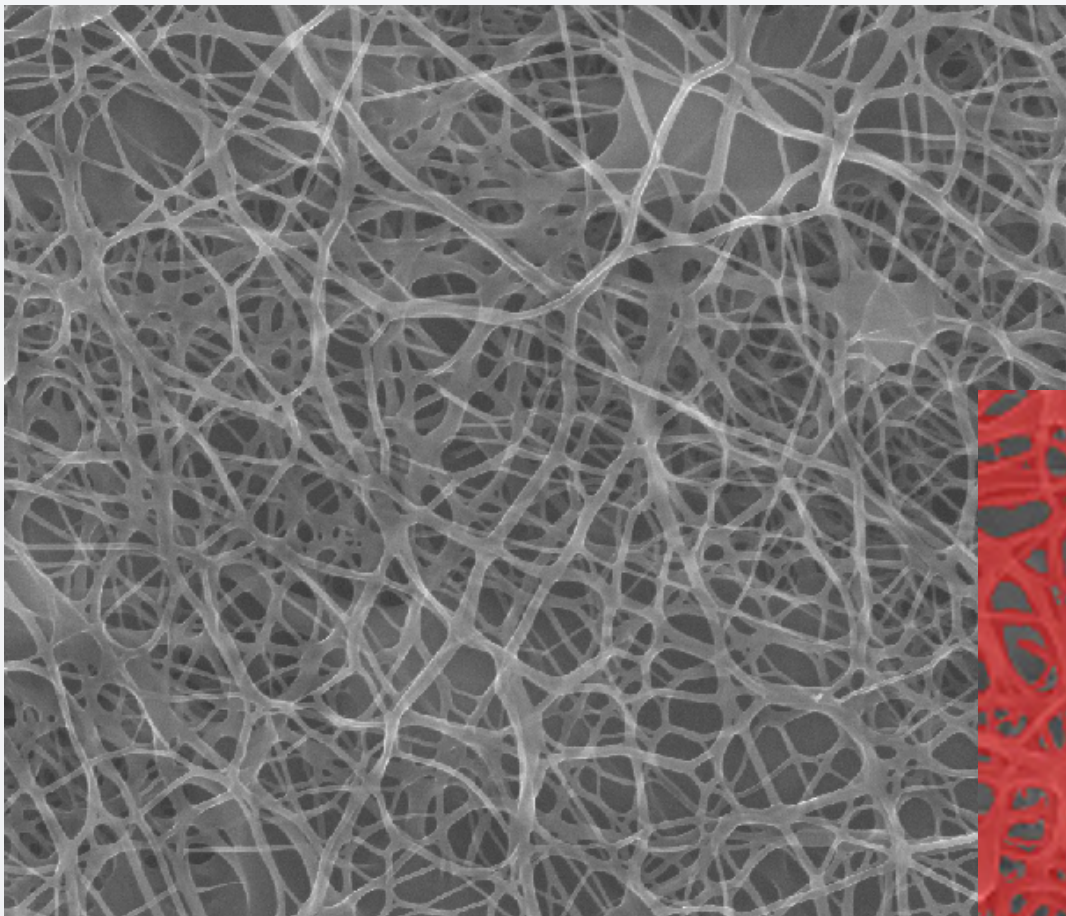
Single recipe accurately measures porosity at each extreme



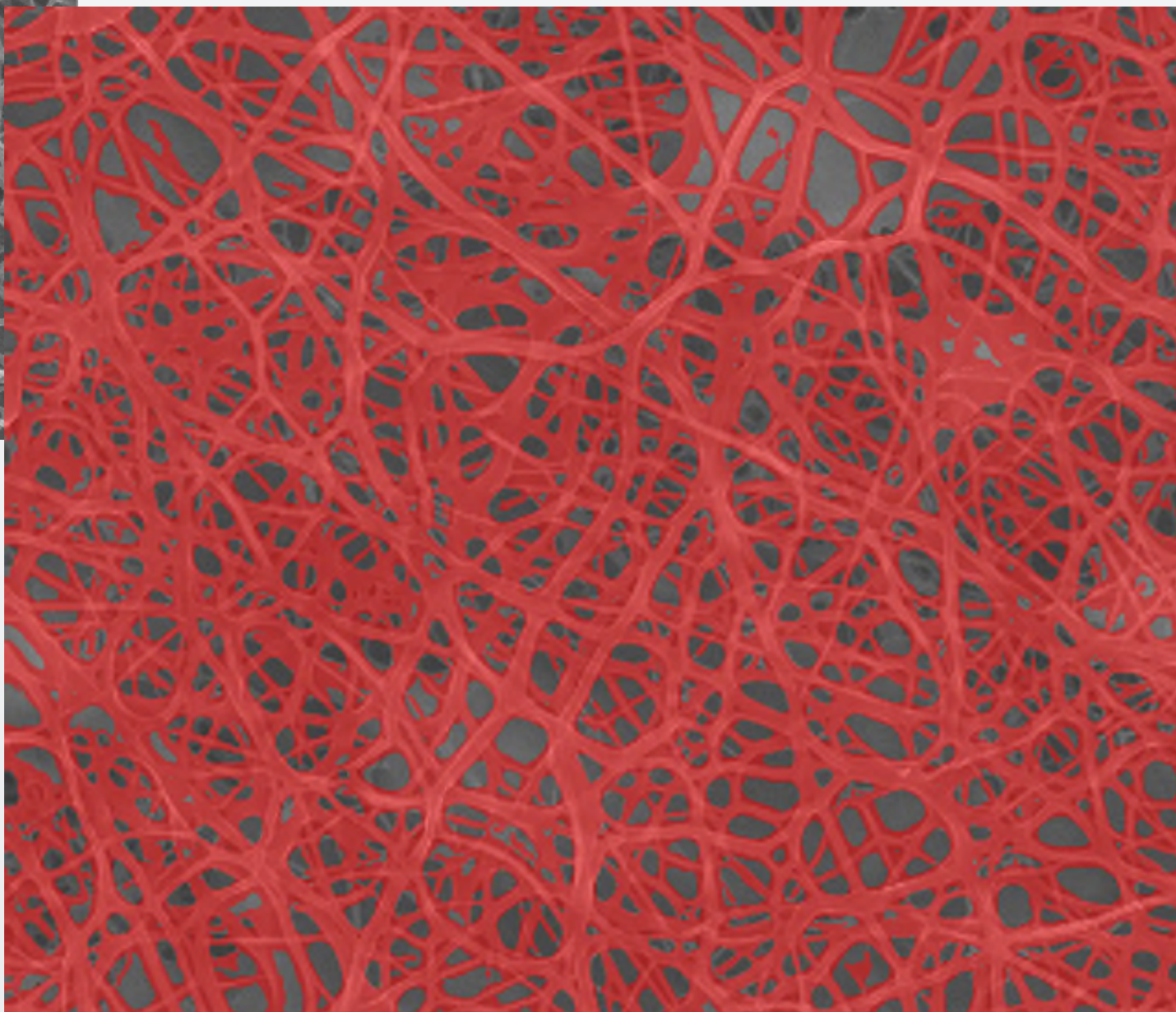
Perform analysis in batch

Fiber Mesh – Localized Quantification

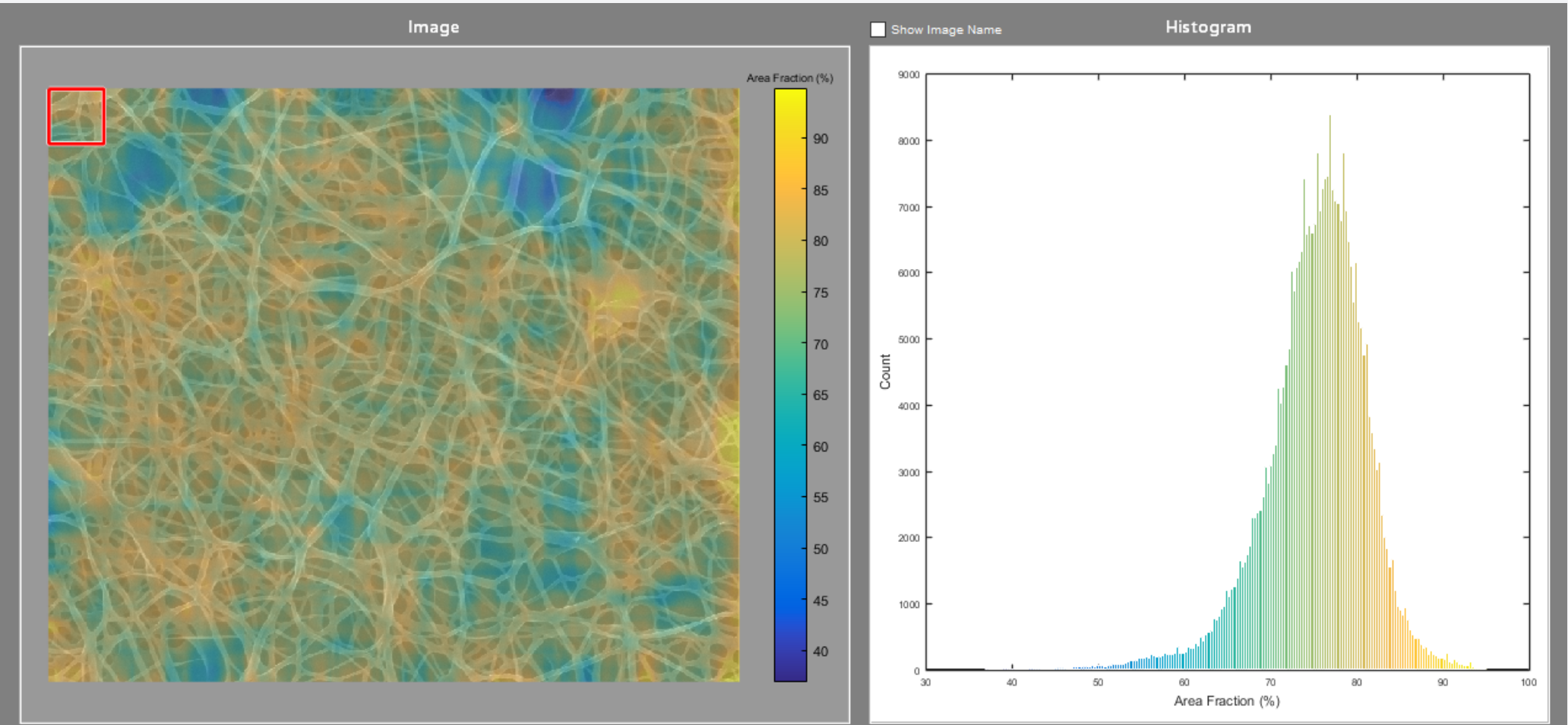
Original



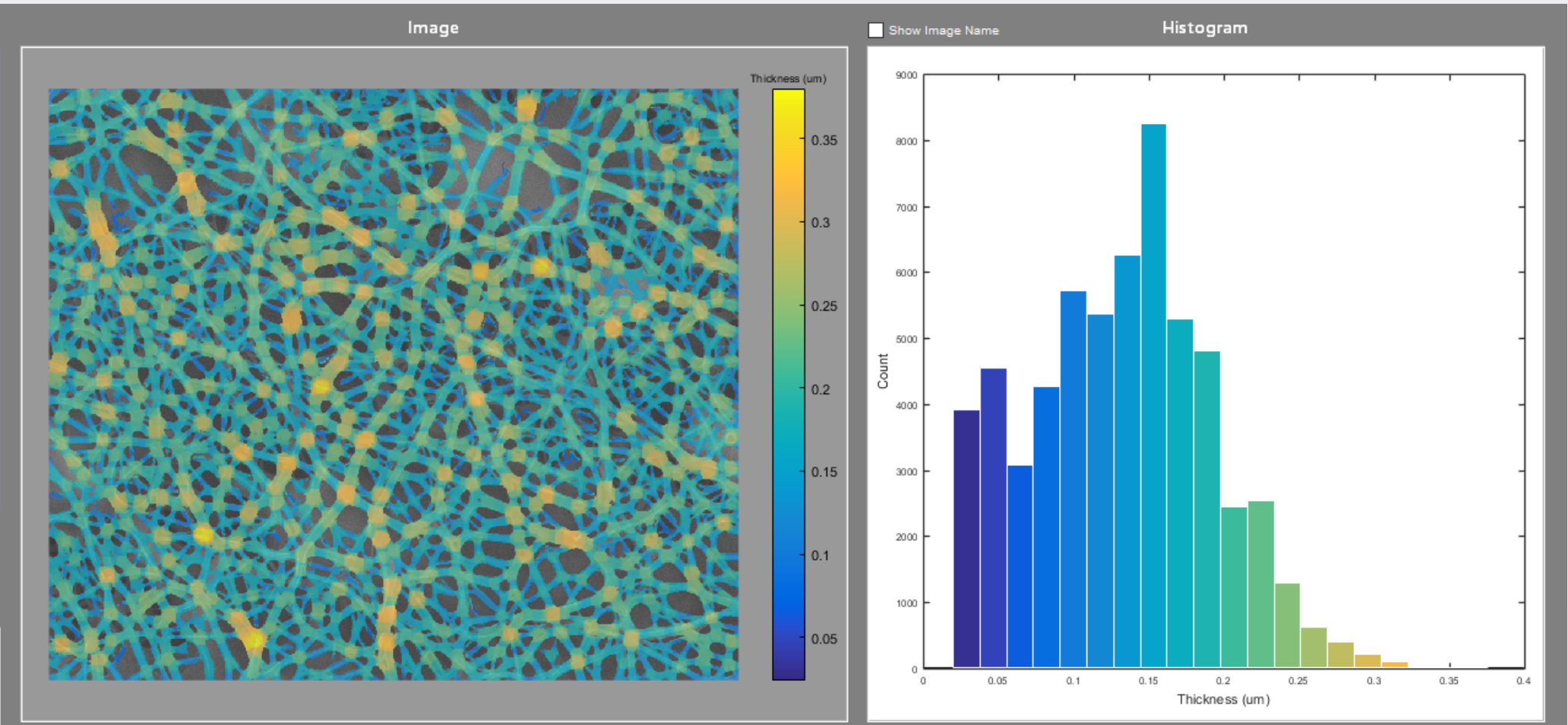
Identified Fibers



Local Fiber Density



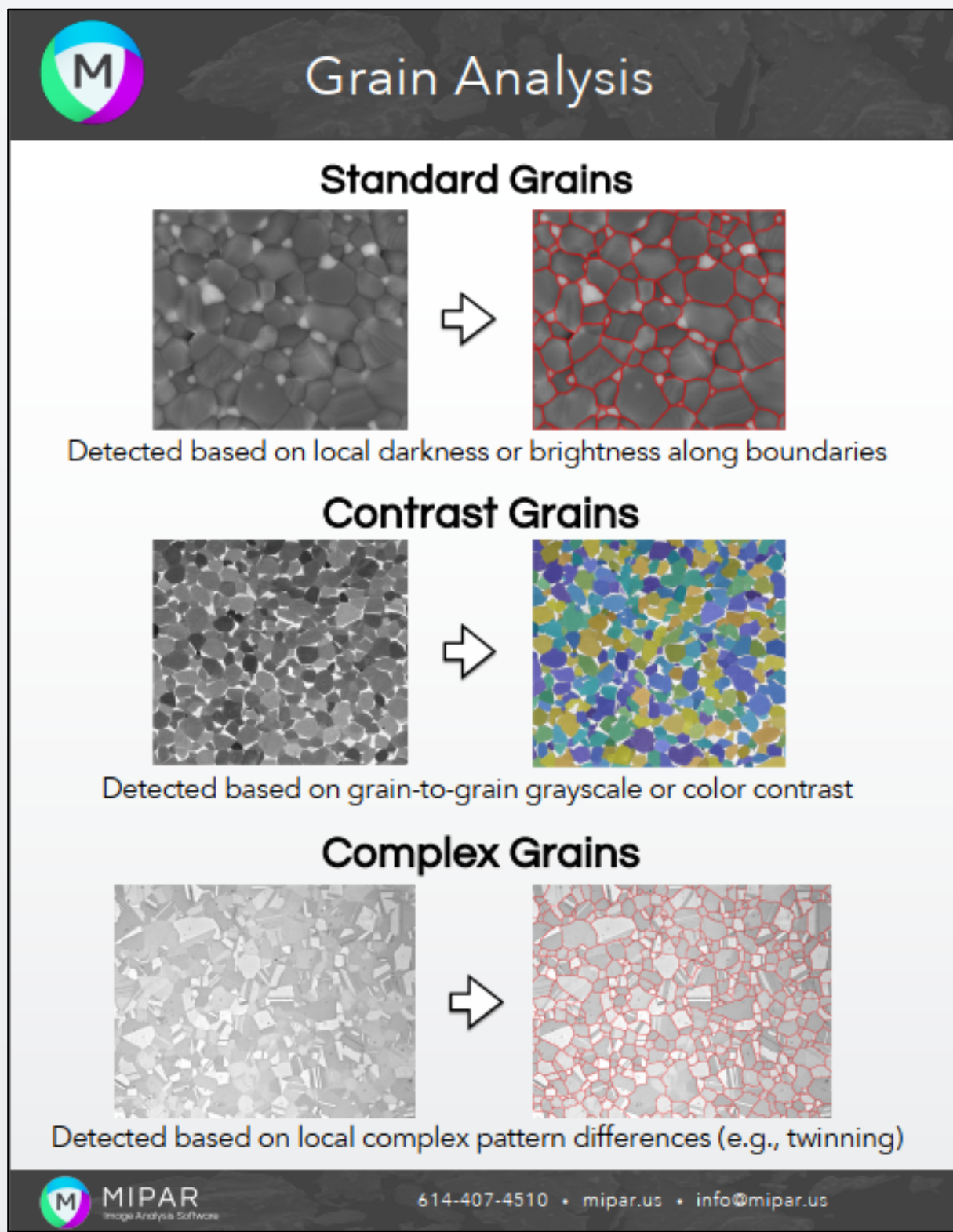
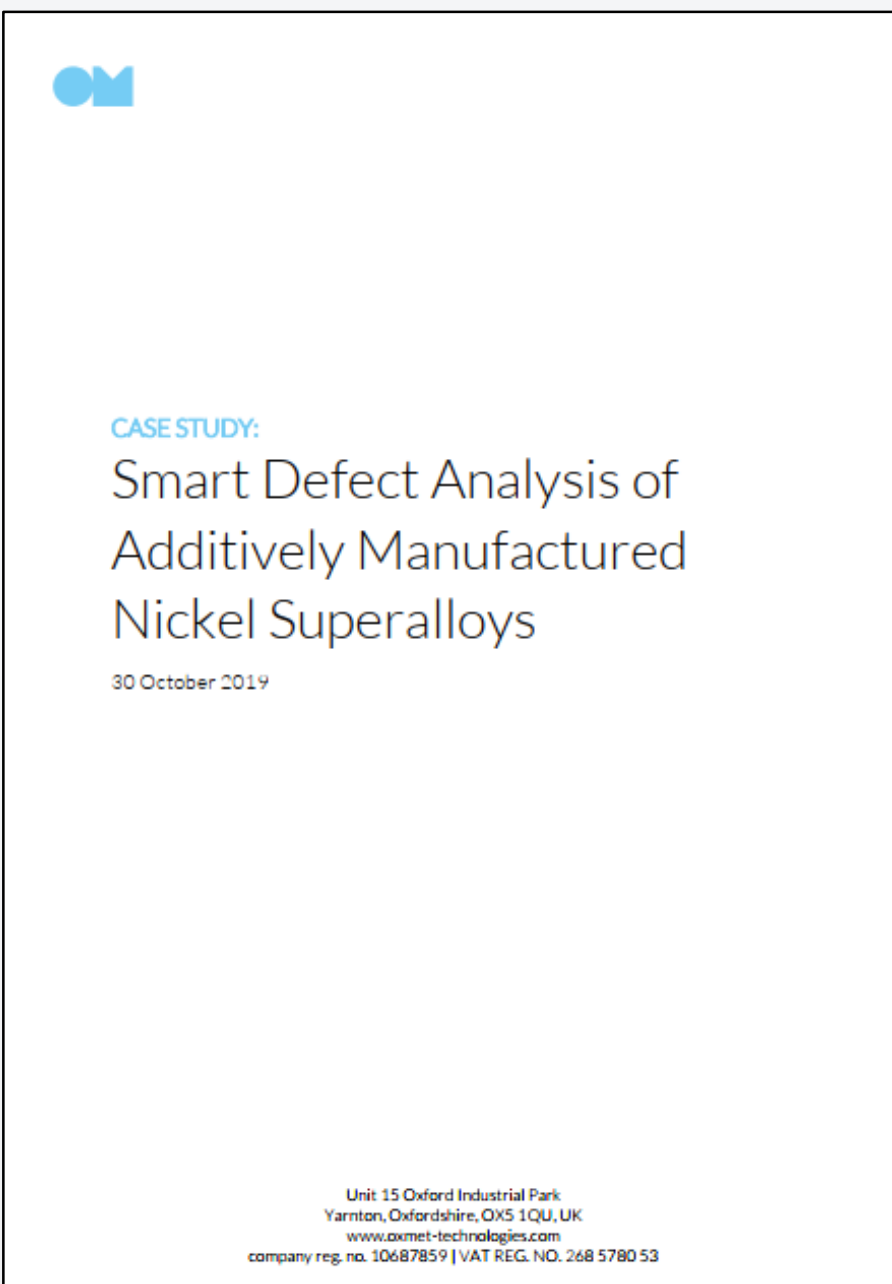
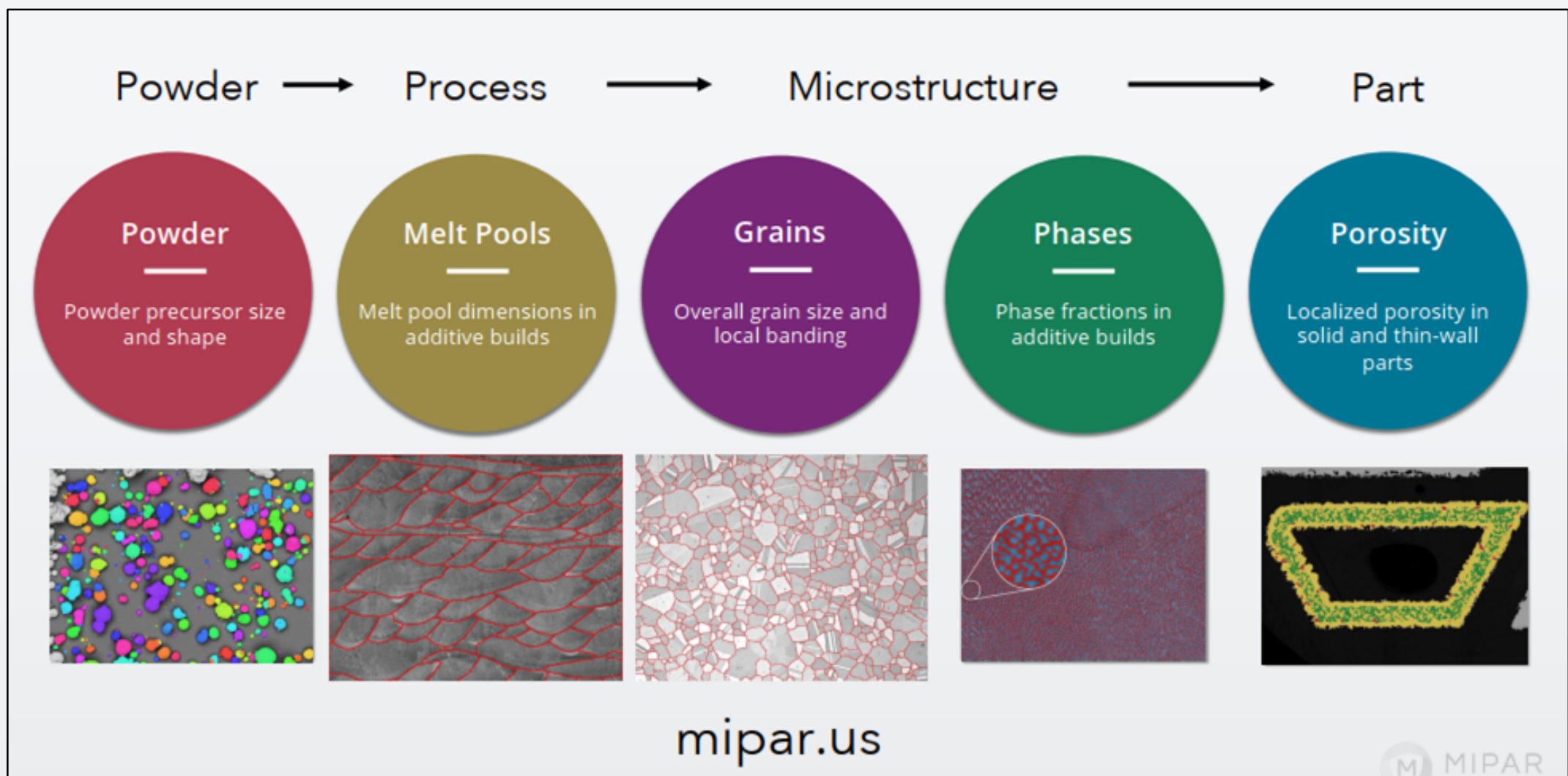
Fiber Thickness Variation



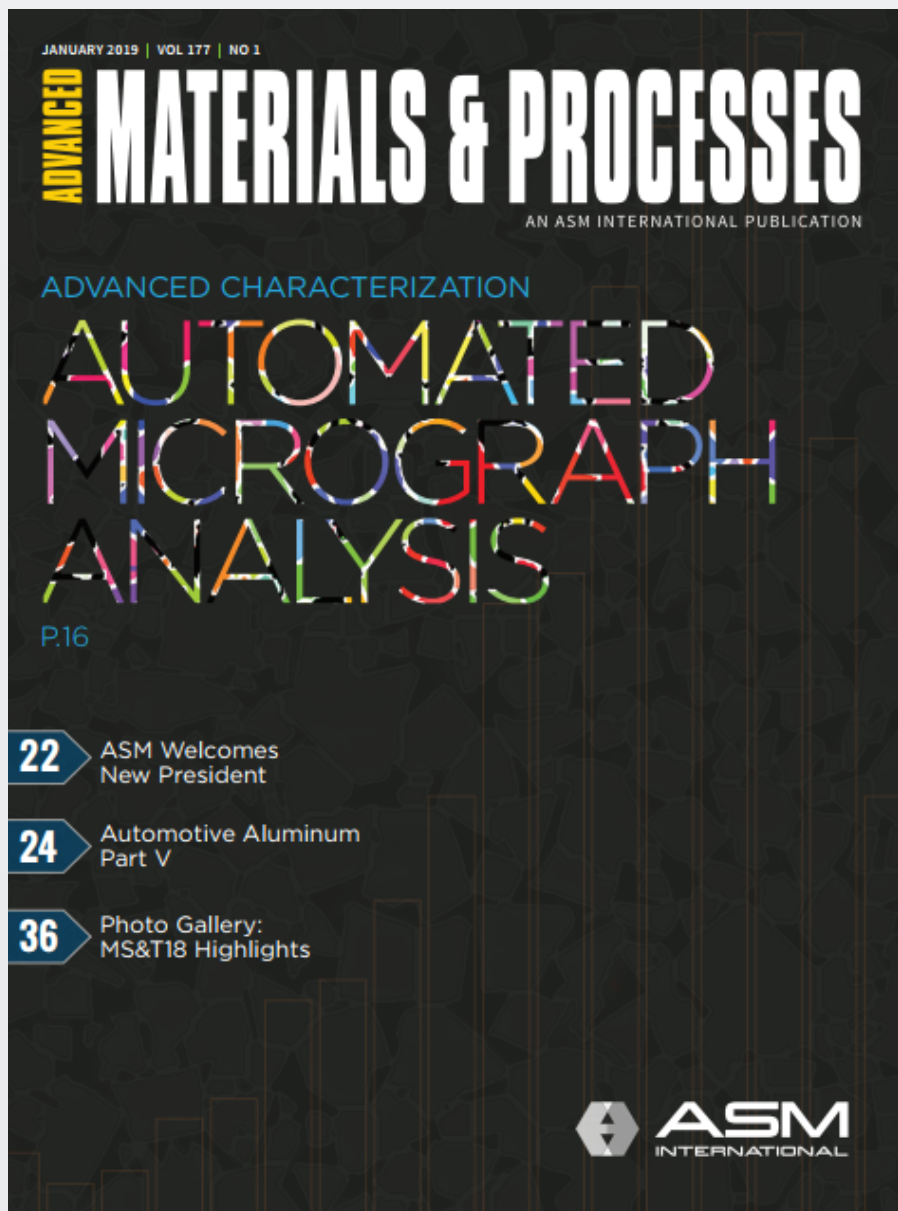
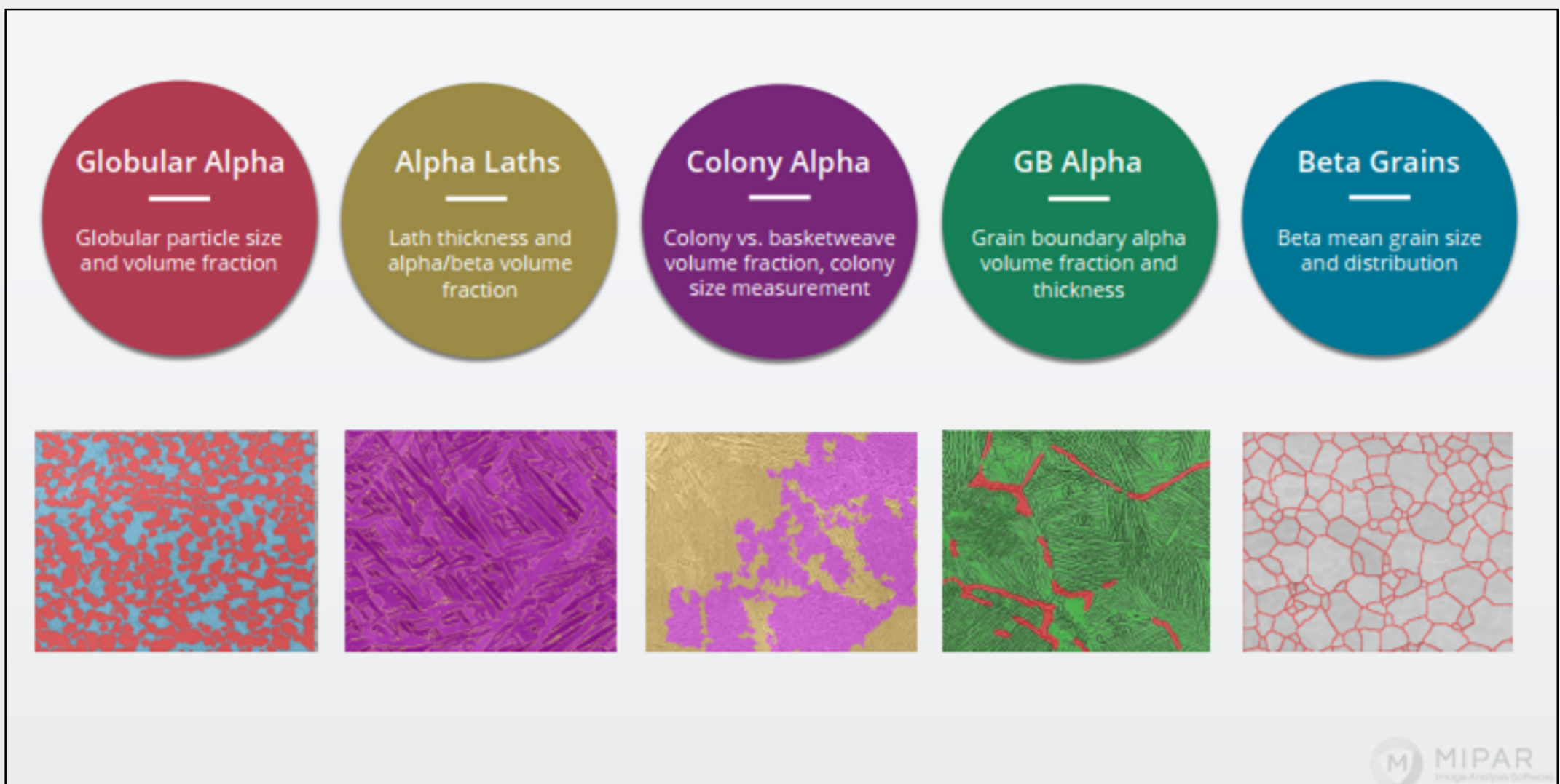
Challenging fibers with intensity similar to background are automatically detected

Metals Applications

Additive Manufacturing



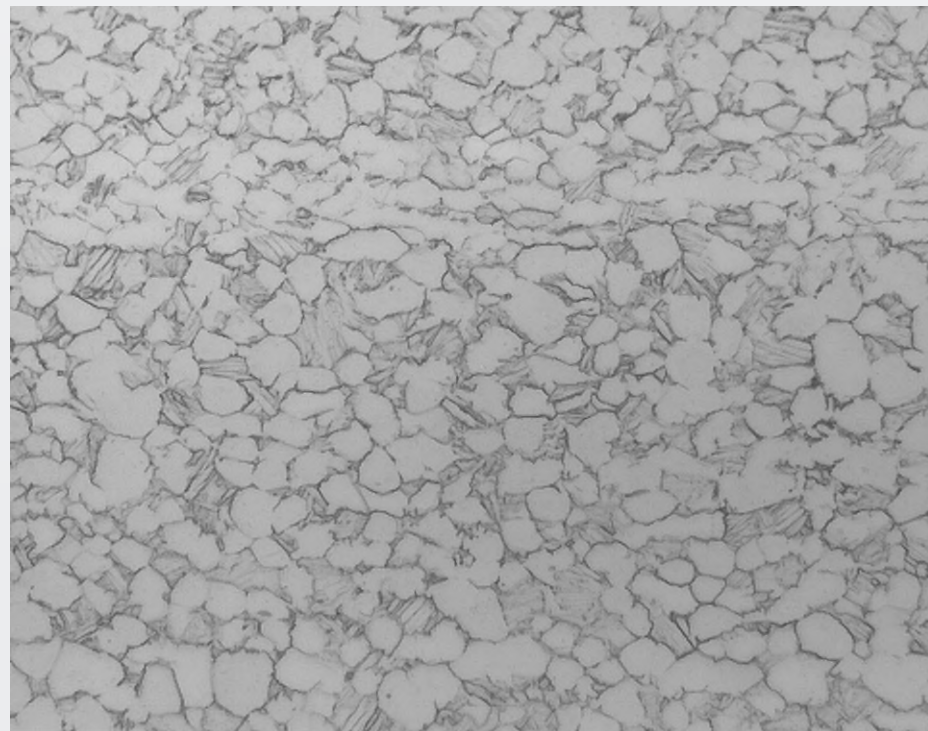
Titanium Research



Key Applications

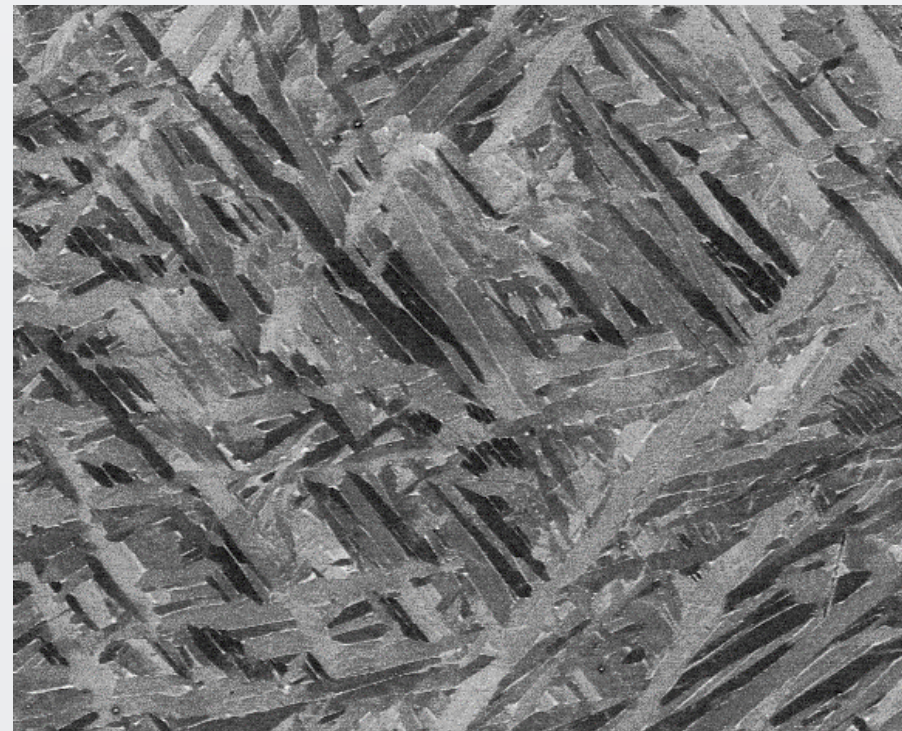
Globular Alpha

Globular particle size
and volume fraction



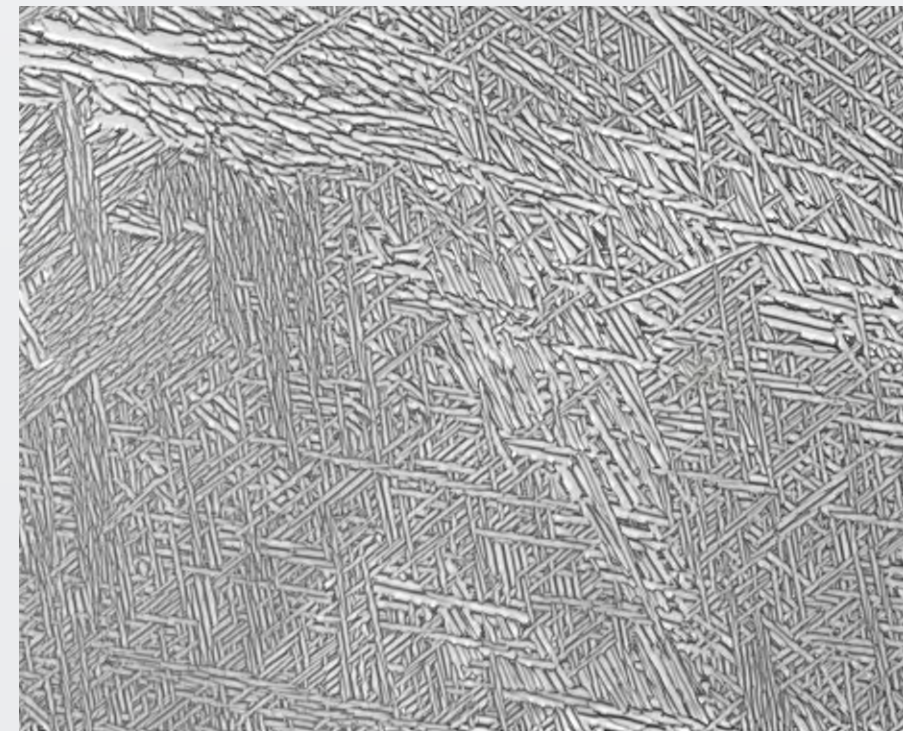
Alpha Laths

Lath thickness and
alpha/beta volume
fraction



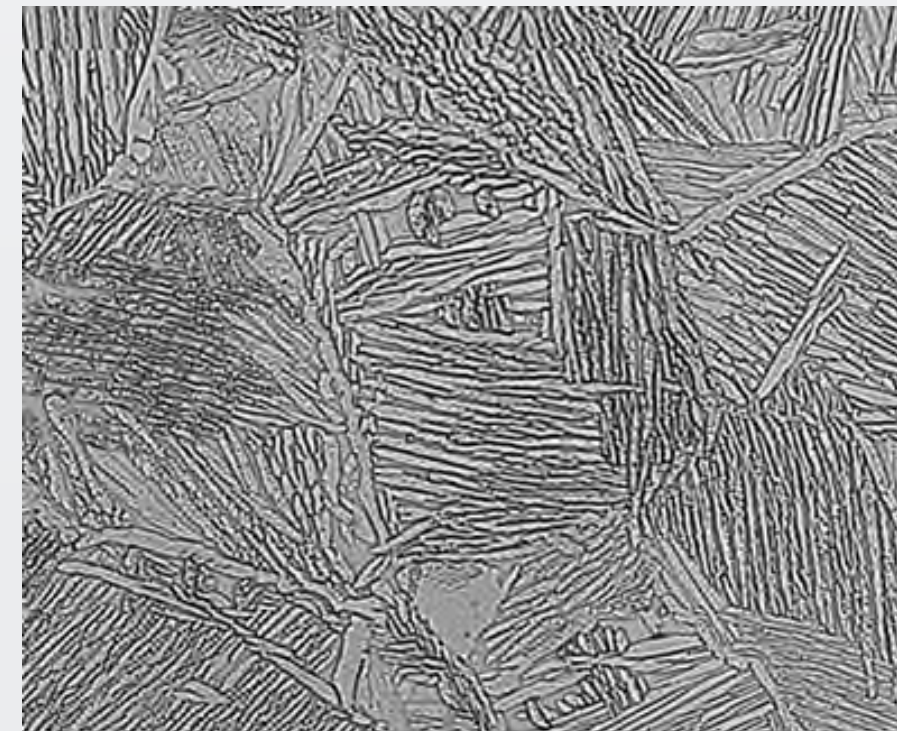
Colony Alpha

Colony vs. basketweave
volume fraction, colony
size measurement



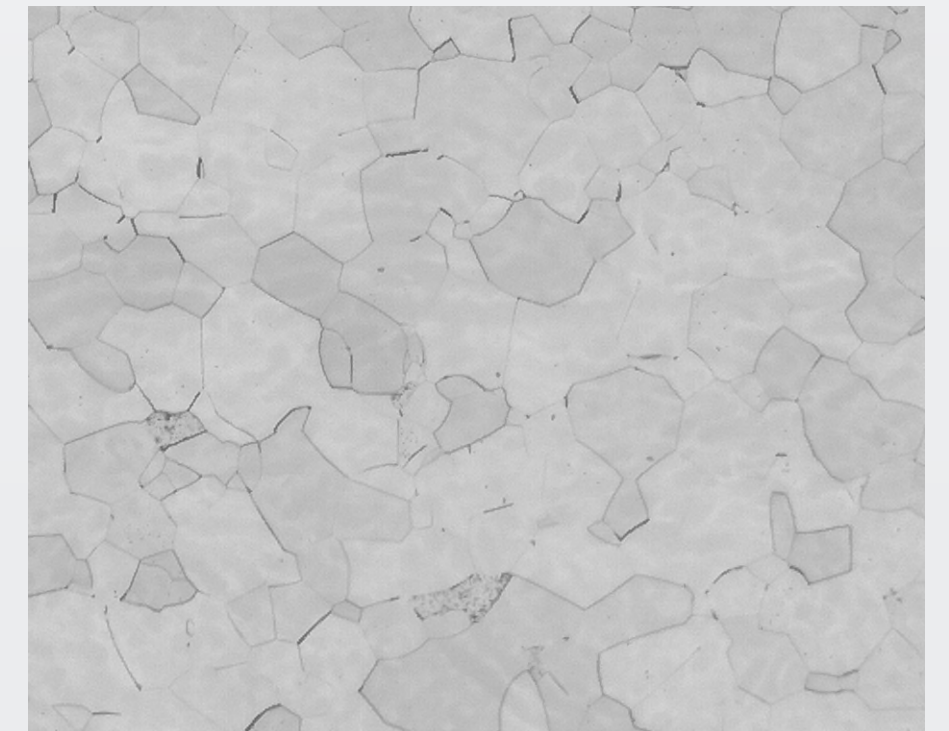
GB Alpha

Grain boundary alpha
volume fraction and
thickness



Beta Grains

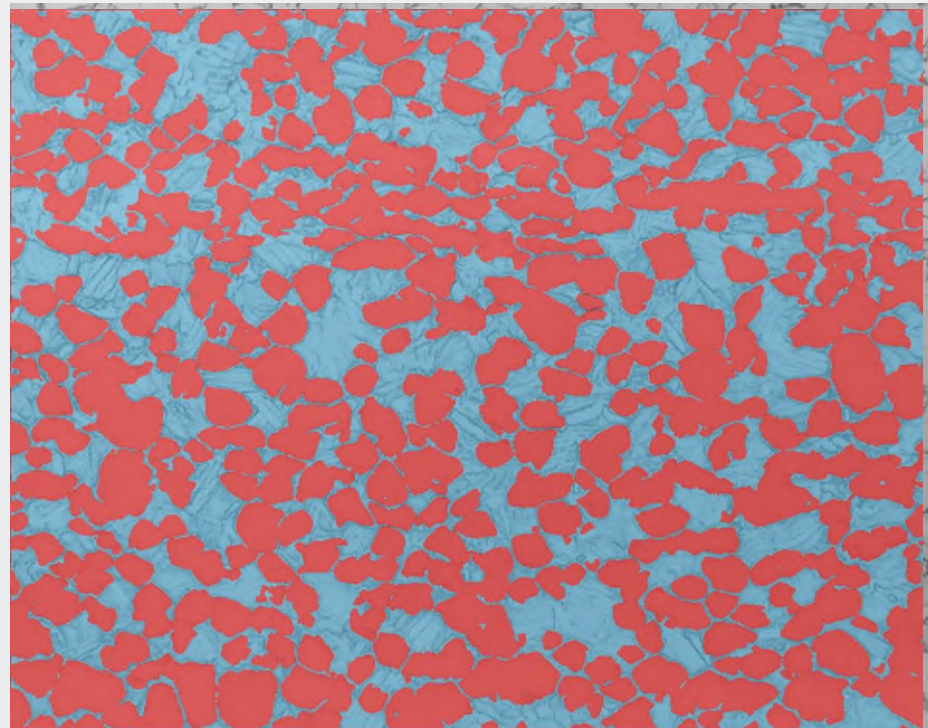
Beta mean grain size
and distribution



Key Applications

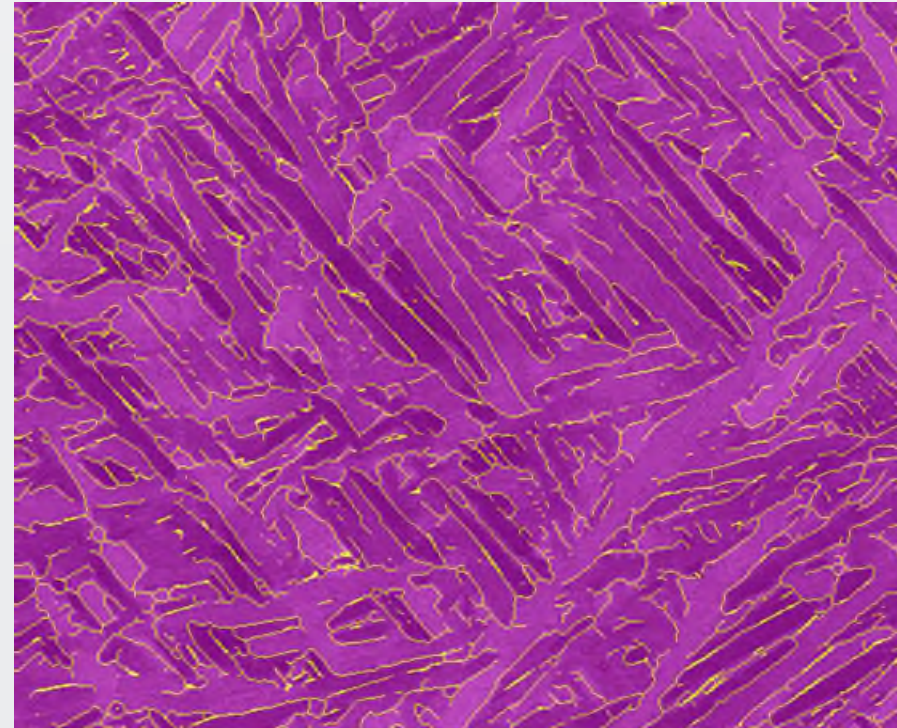
Globular Alpha

Globular particle size
and volume fraction



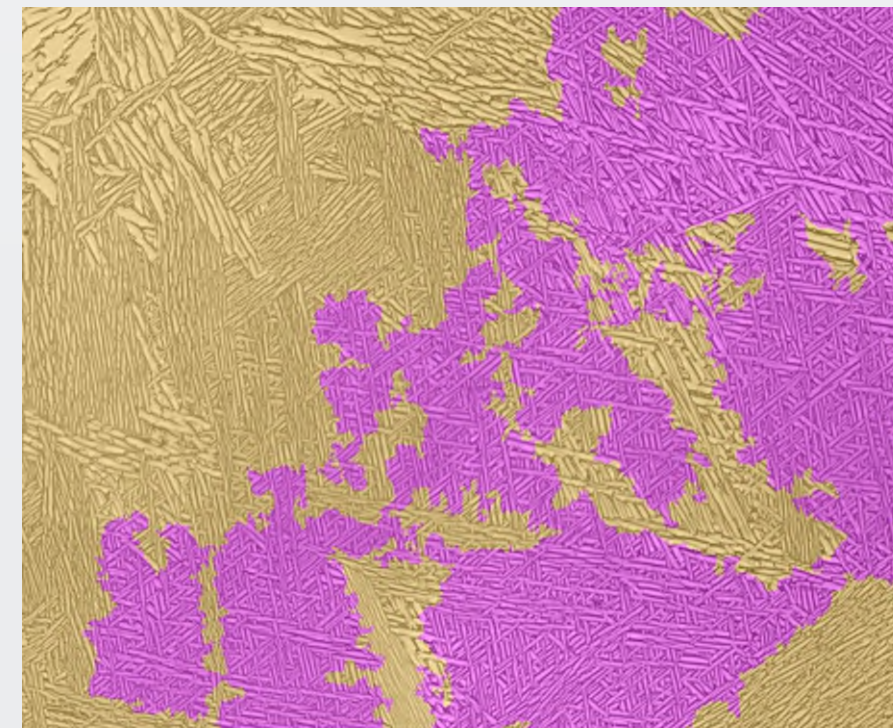
Alpha Laths

Lath thickness and
alpha/beta volume
fraction



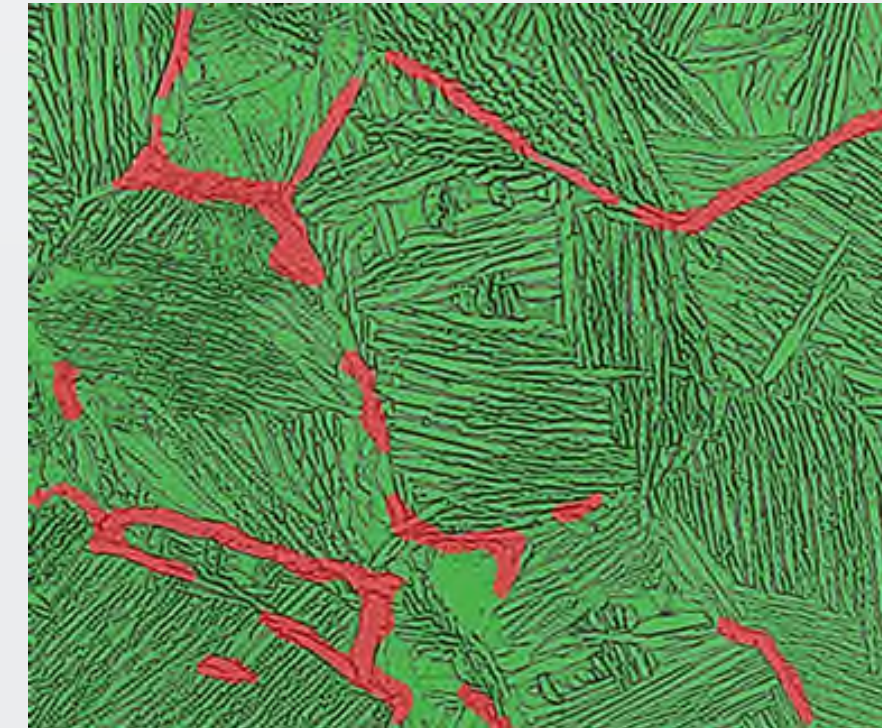
Colony Alpha

Colony vs. basketweave
volume fraction, colony
size measurement



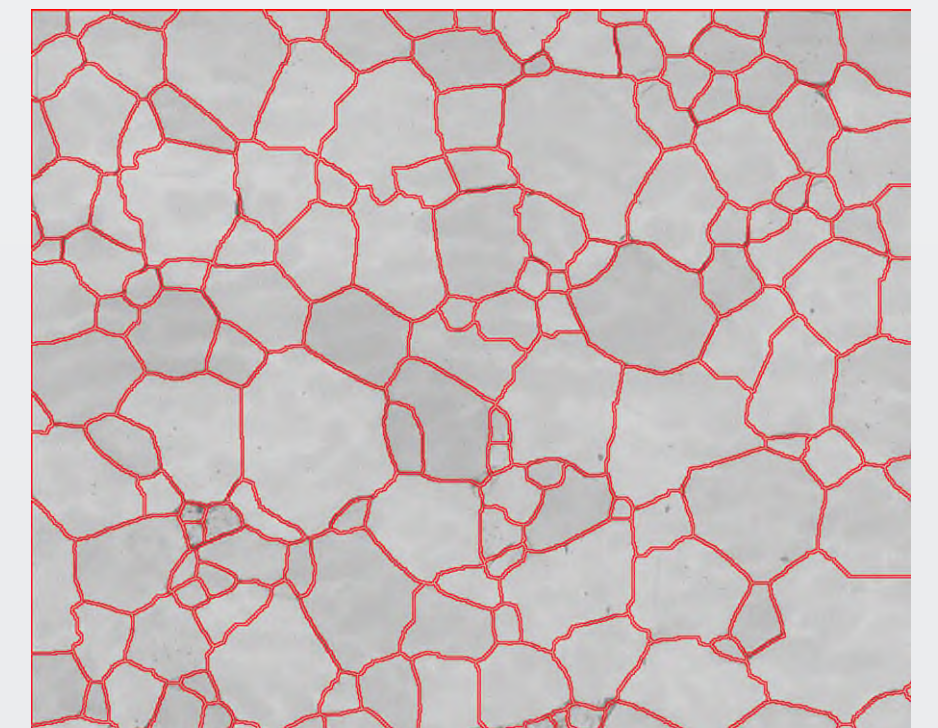
GB Alpha

Grain boundary alpha
volume fraction and
thickness



Beta Grains

Beta mean grain size
and distribution



Globular Alpha: Optical

Globular

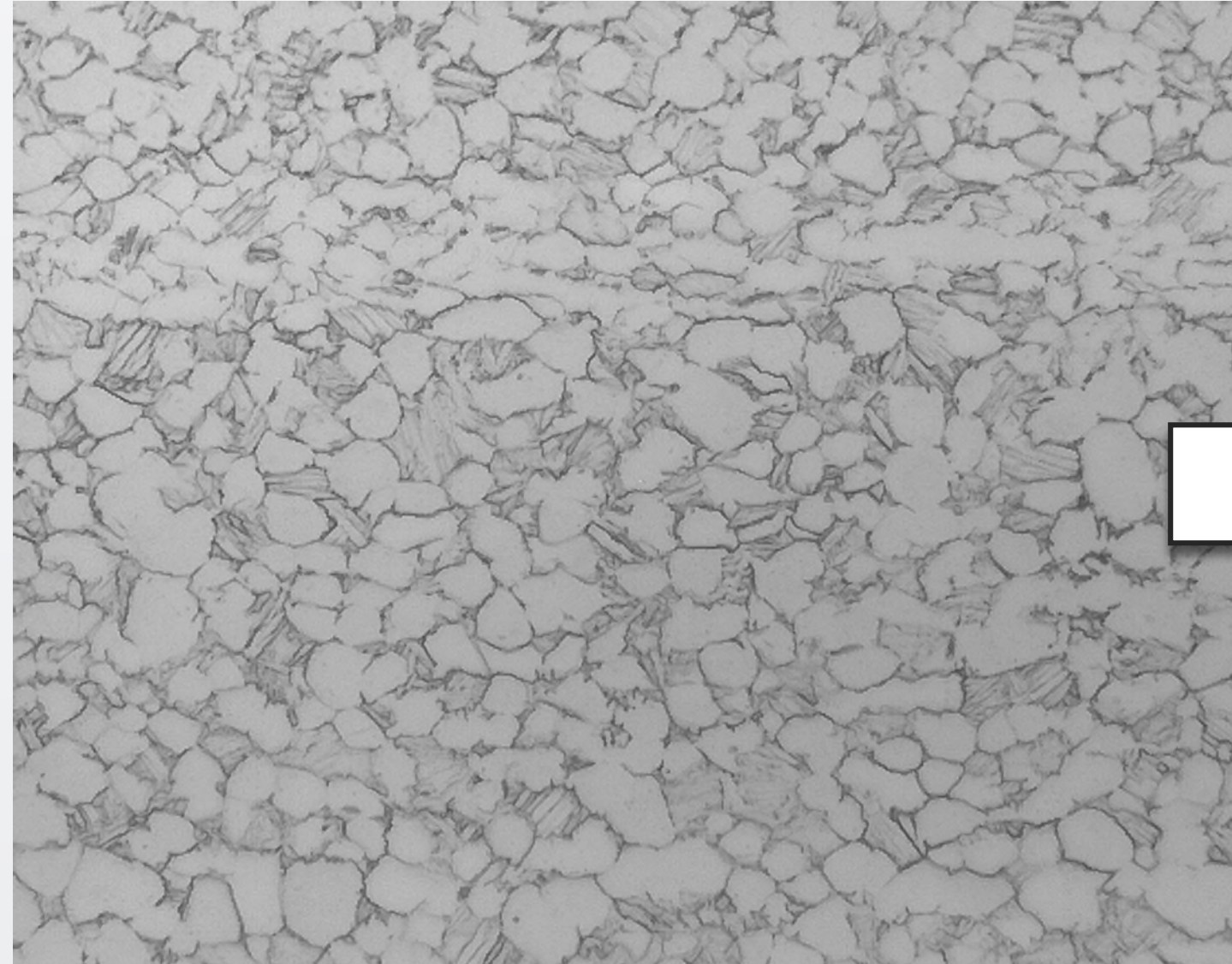
Laths

Colonies

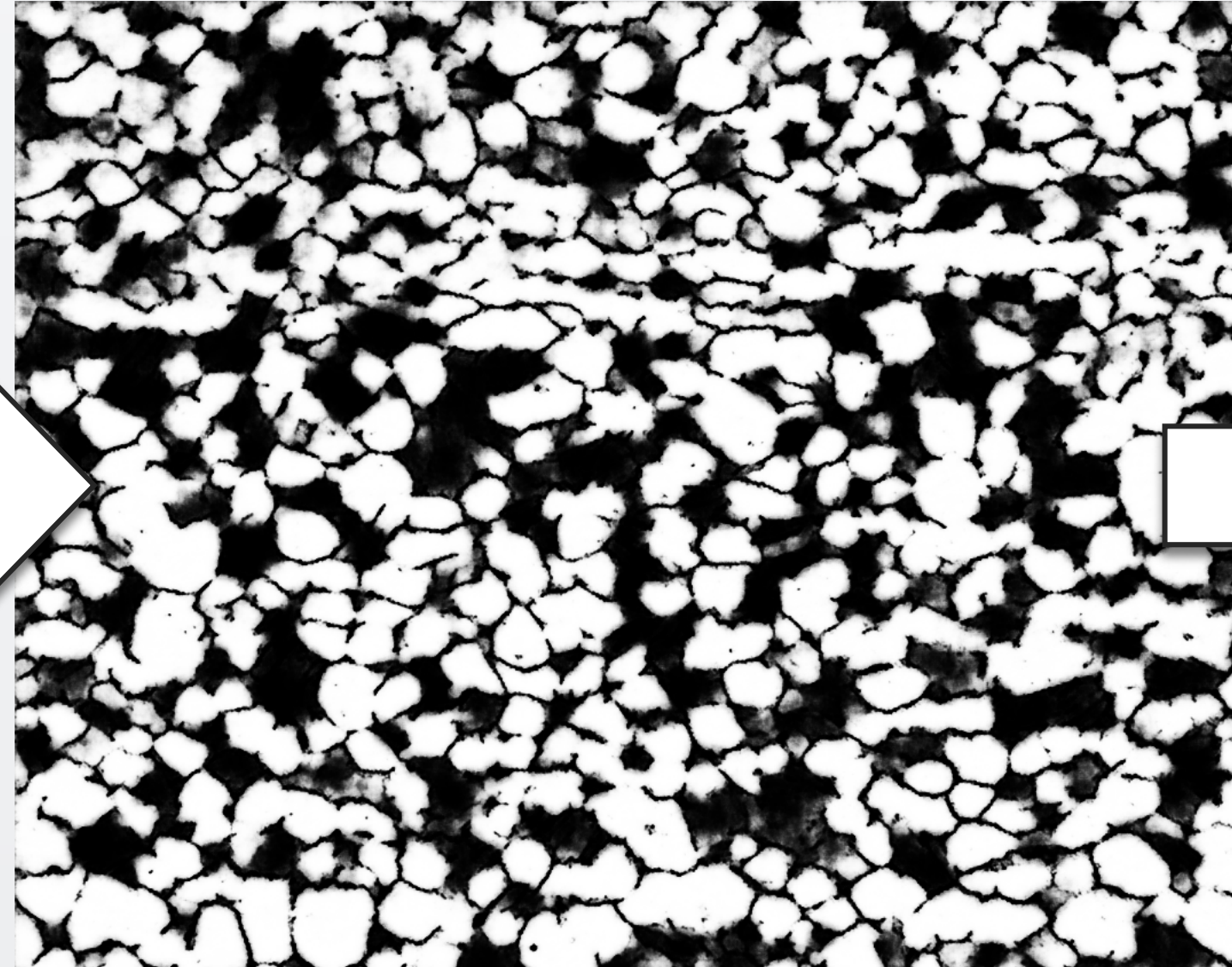
GB Alpha

Grains

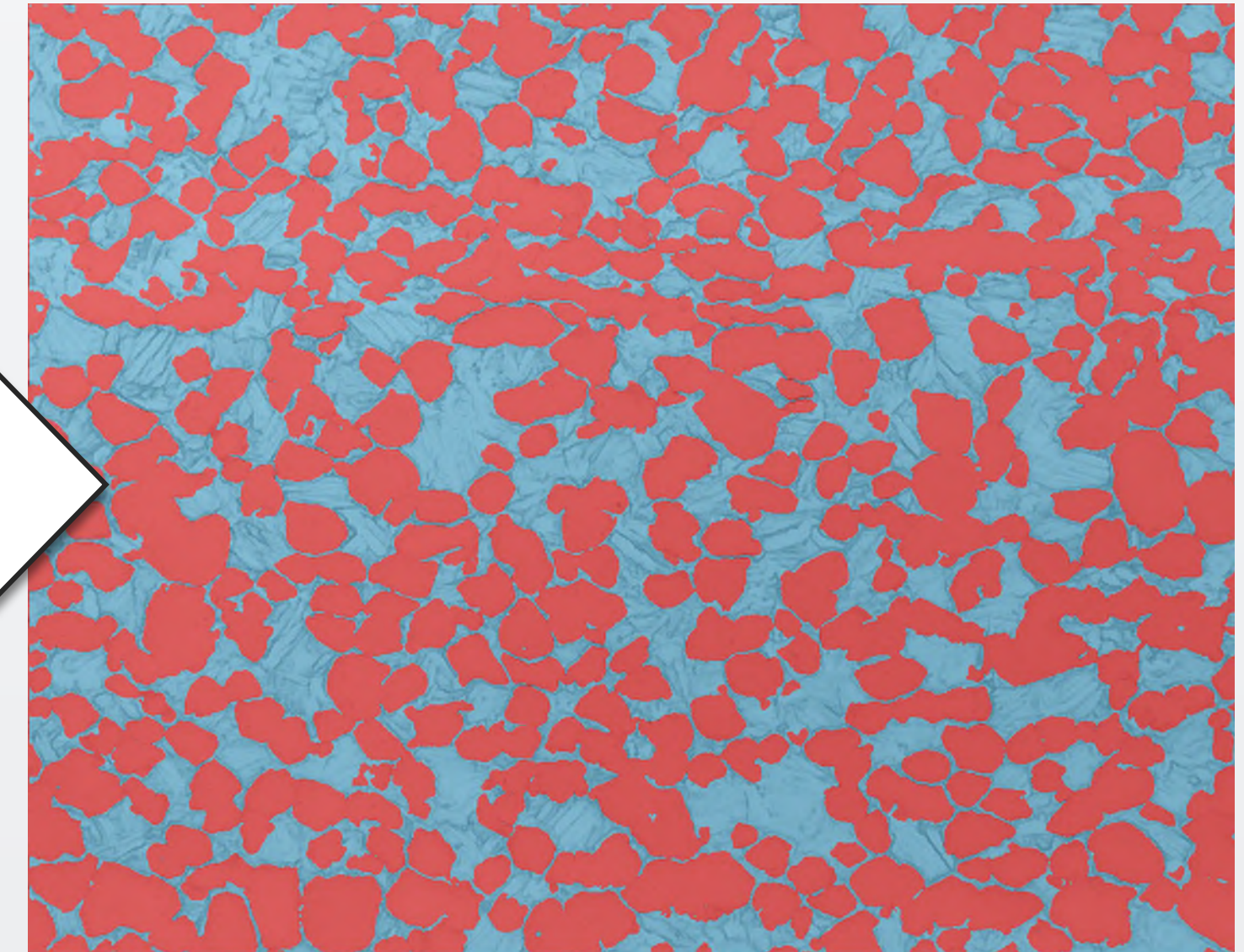
Original Image



Deep Learning Applied



Final Segmentation



GLOBALAR FRACTION: 61%

- ✓ Model accurately detects globular alpha
- ✓ Avoids false positives in challenging transformation regions
- ✓ Globular percentage and size measurements possible

Globular Alpha: SEM

Globular

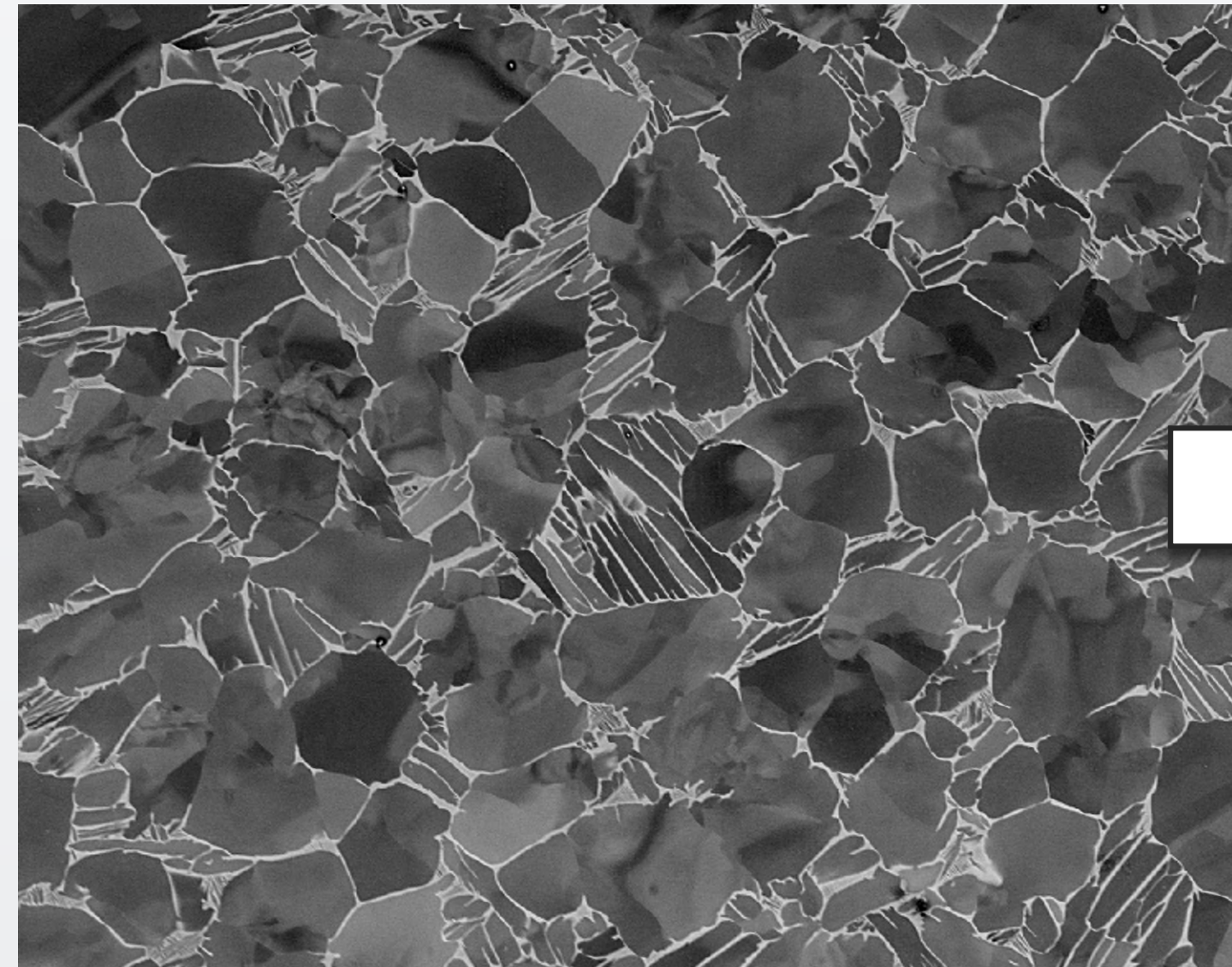
Laths

Colonies

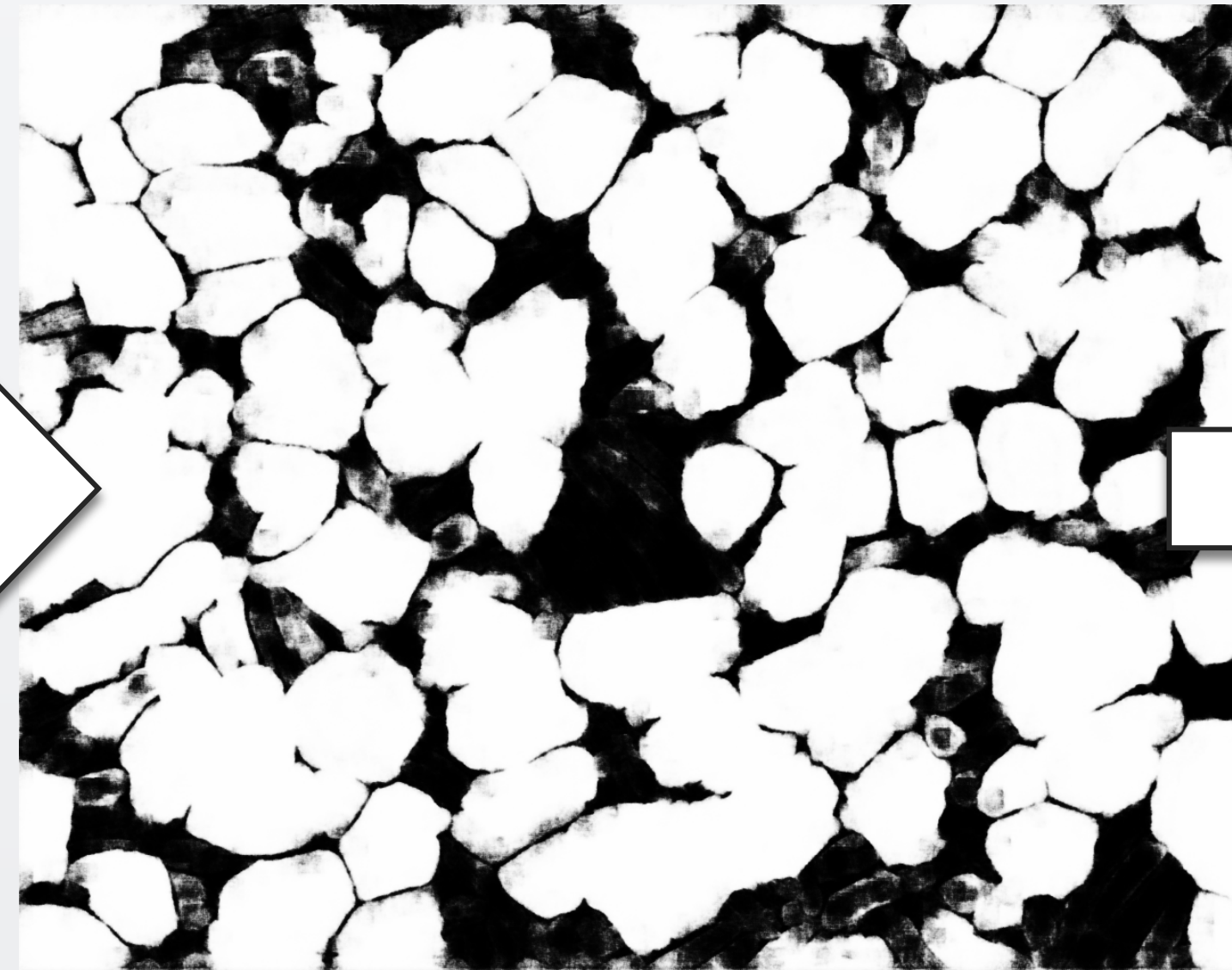
GB Alpha

Grains

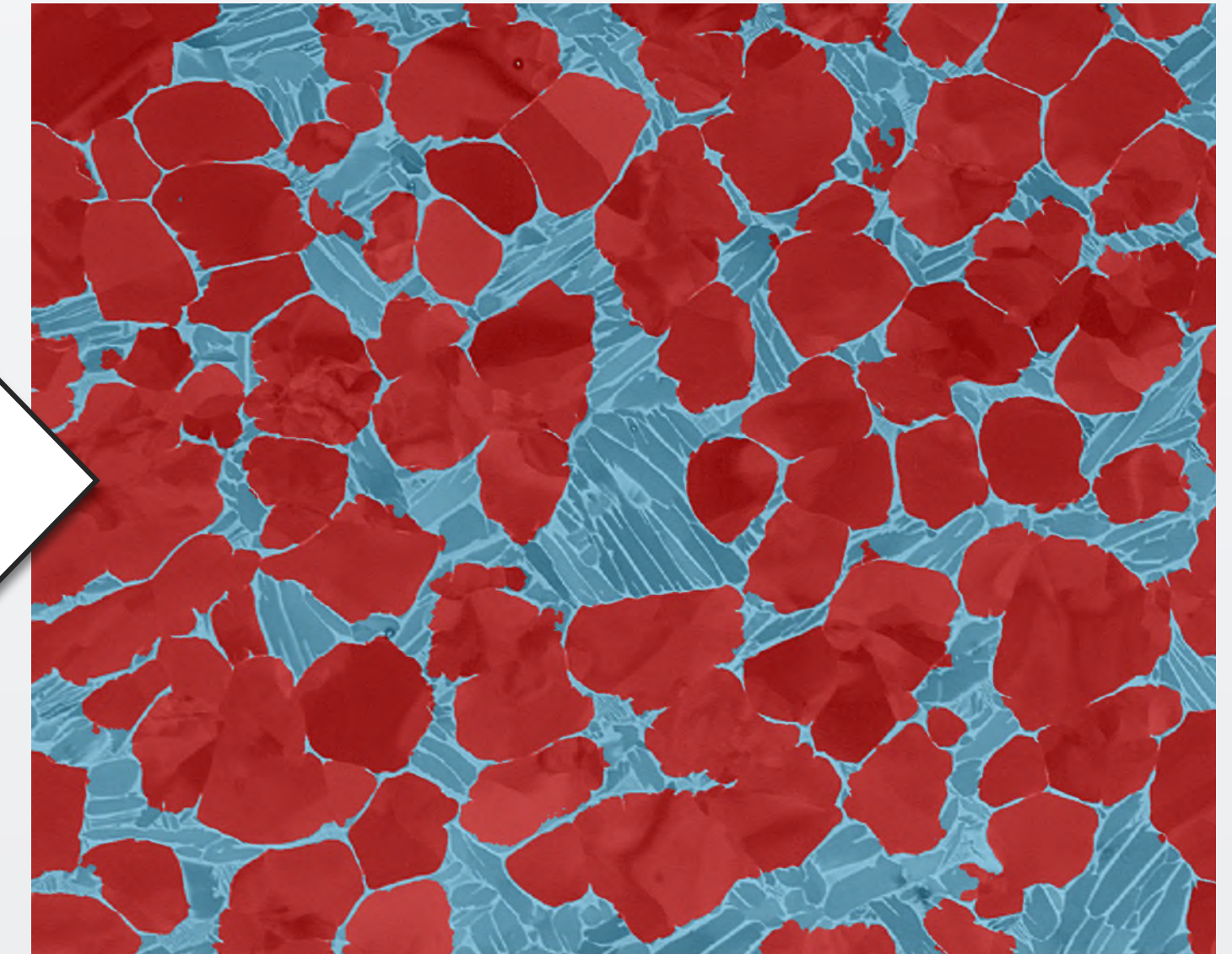
Original Image



Deep Learning Applied



Final Segmentation



GLOBULAR FRACTION: 72%



Model trained in **20 mins on GPU** (3.5 hours on CPU)



Model applied to new image in **1 sec on GPU** (10 sec on CPU)

Alpha Laths: Width

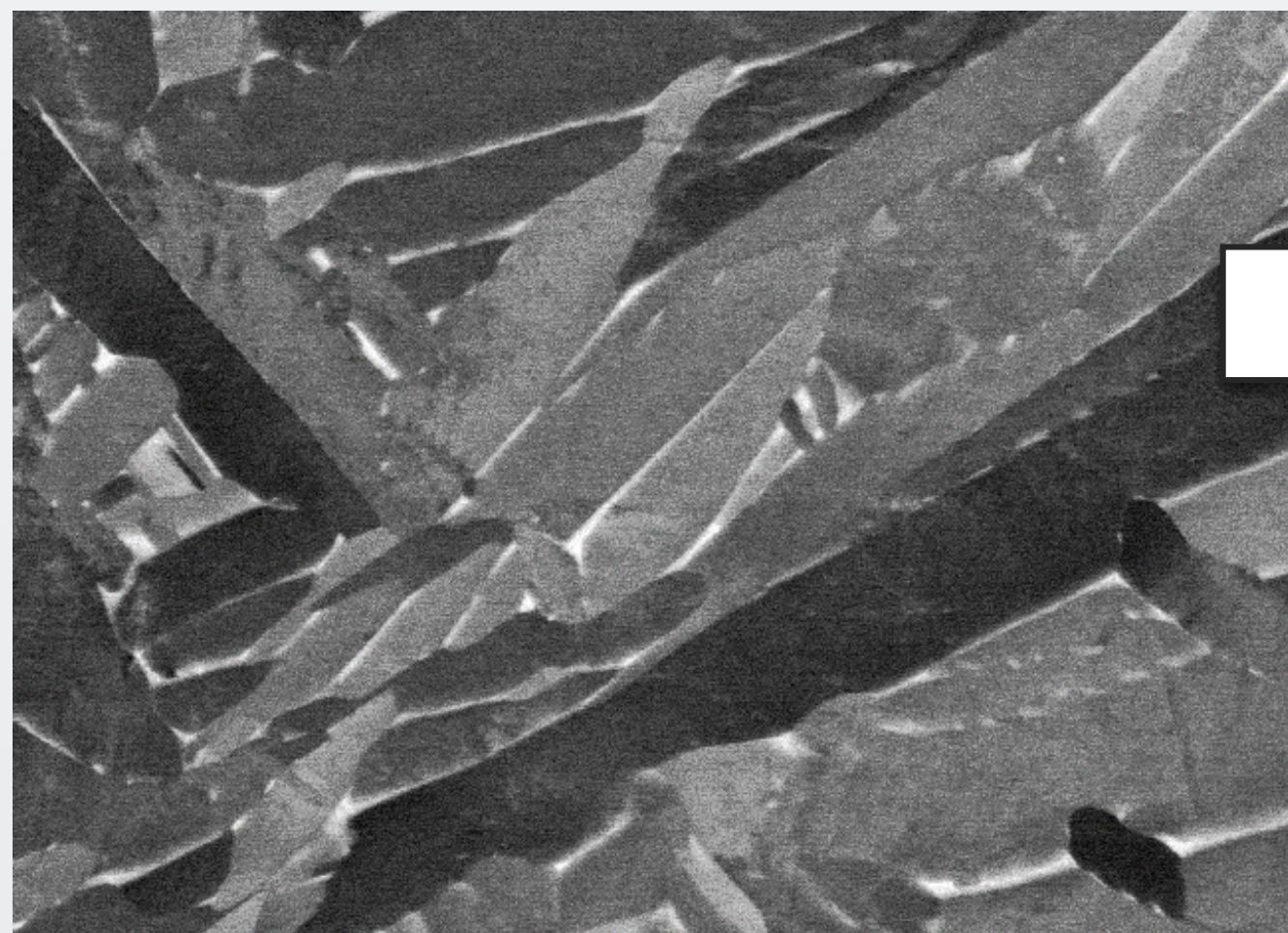
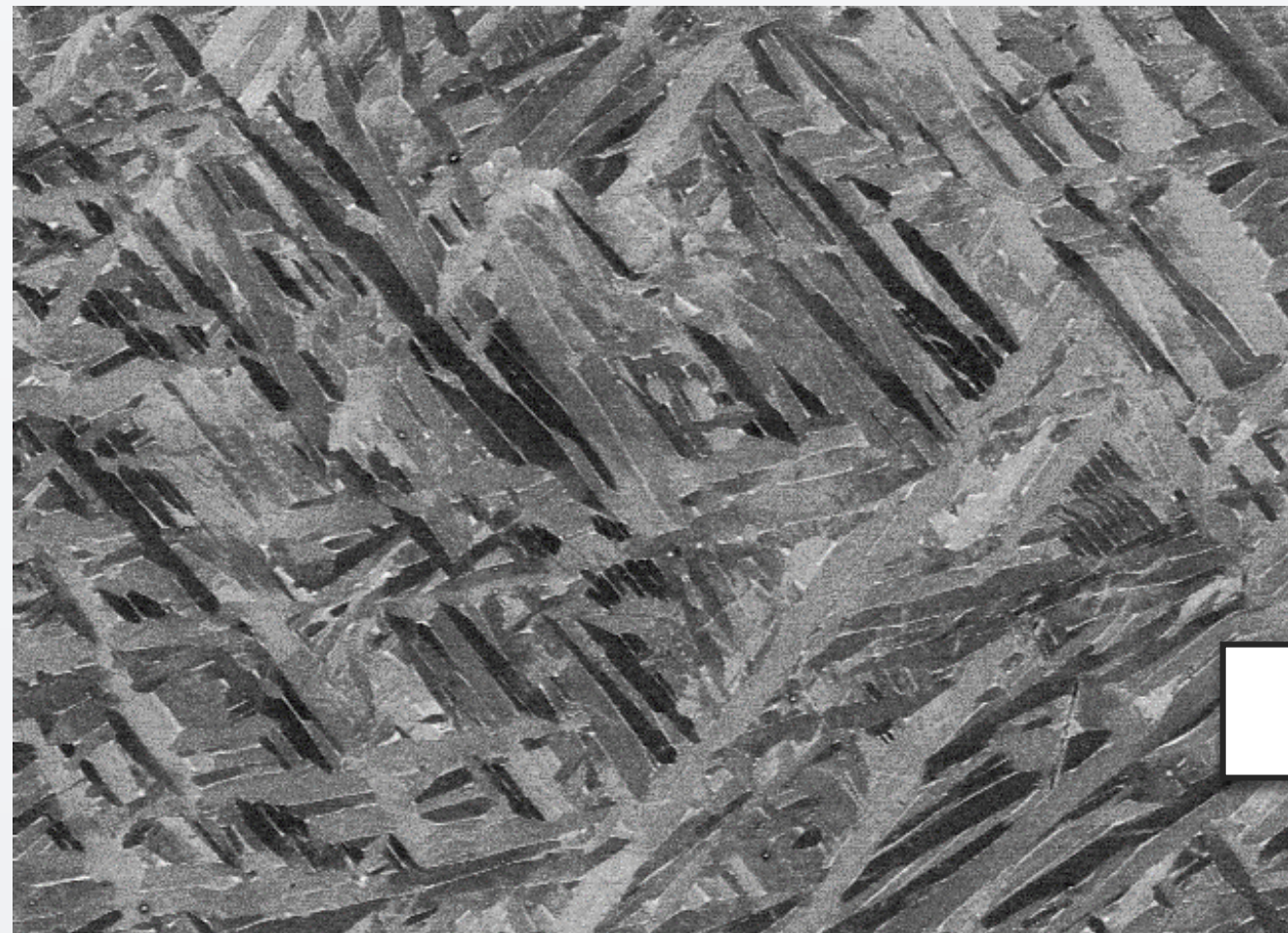
Globular

Laths

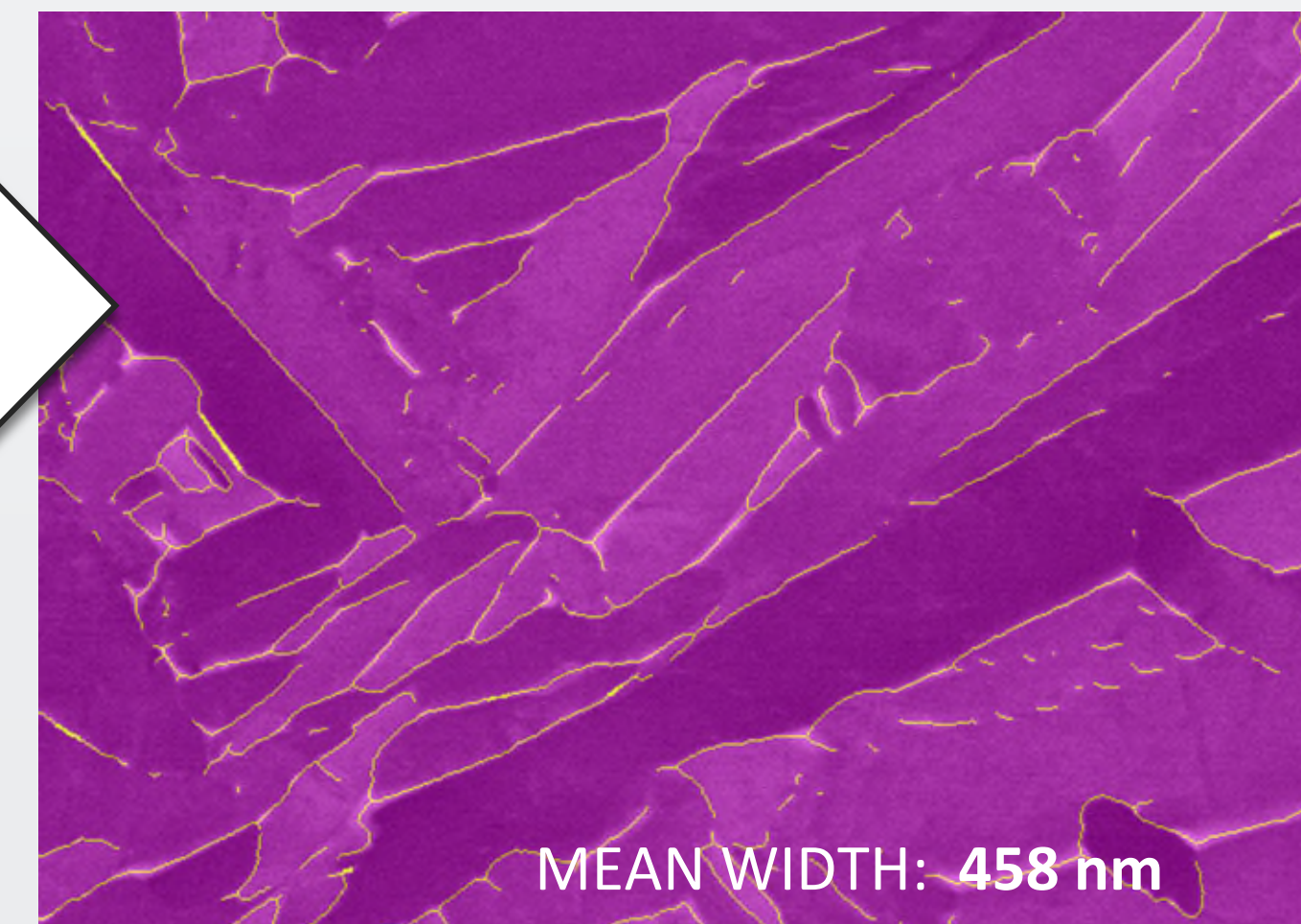
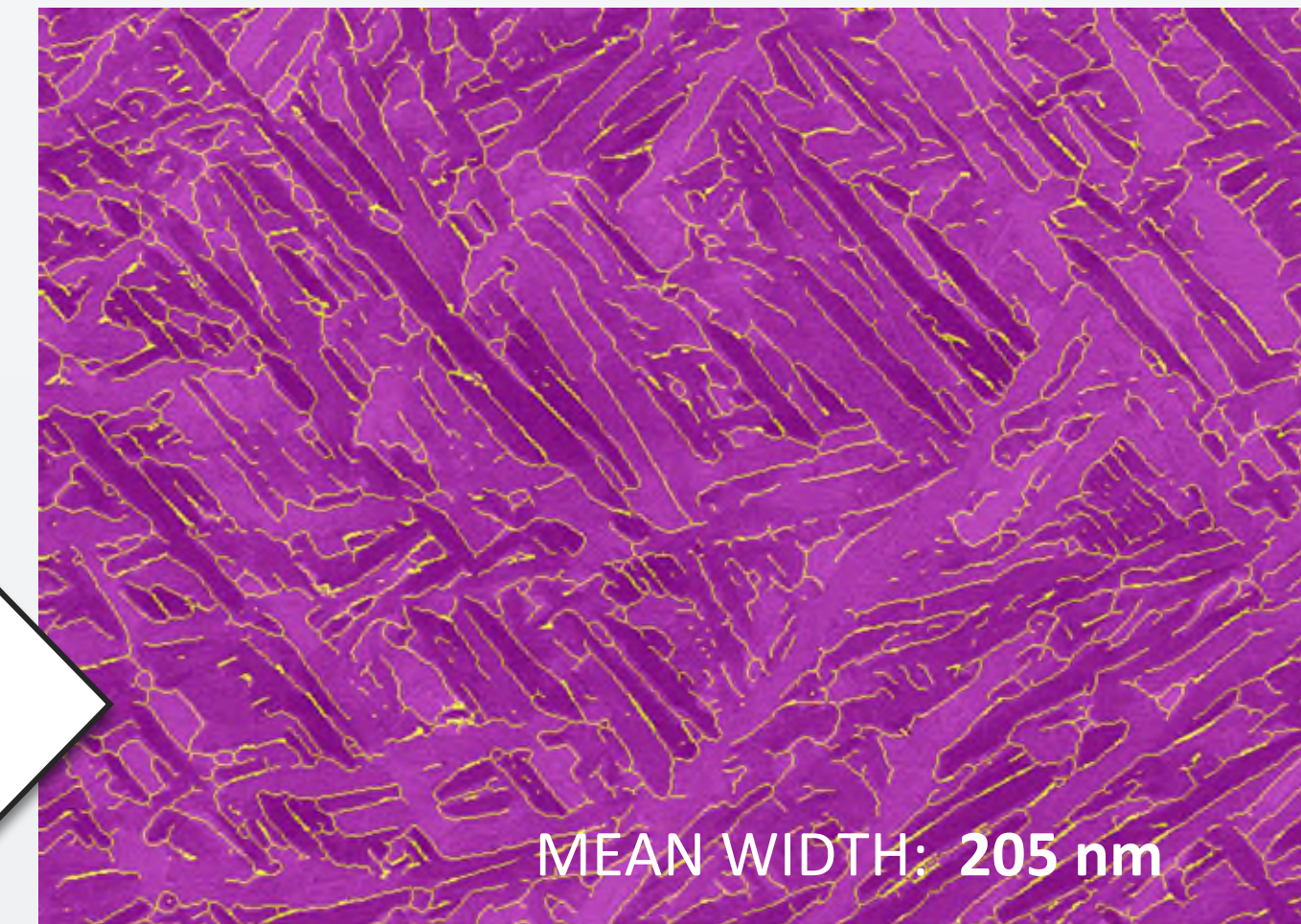
Colonies

GB Alpha

Grains



Deep
Learning
Model
#1



Identical algorithm works on different length scales



Lath width measured via *Gundersen approximation*

Alpha Laths: Phase Fraction

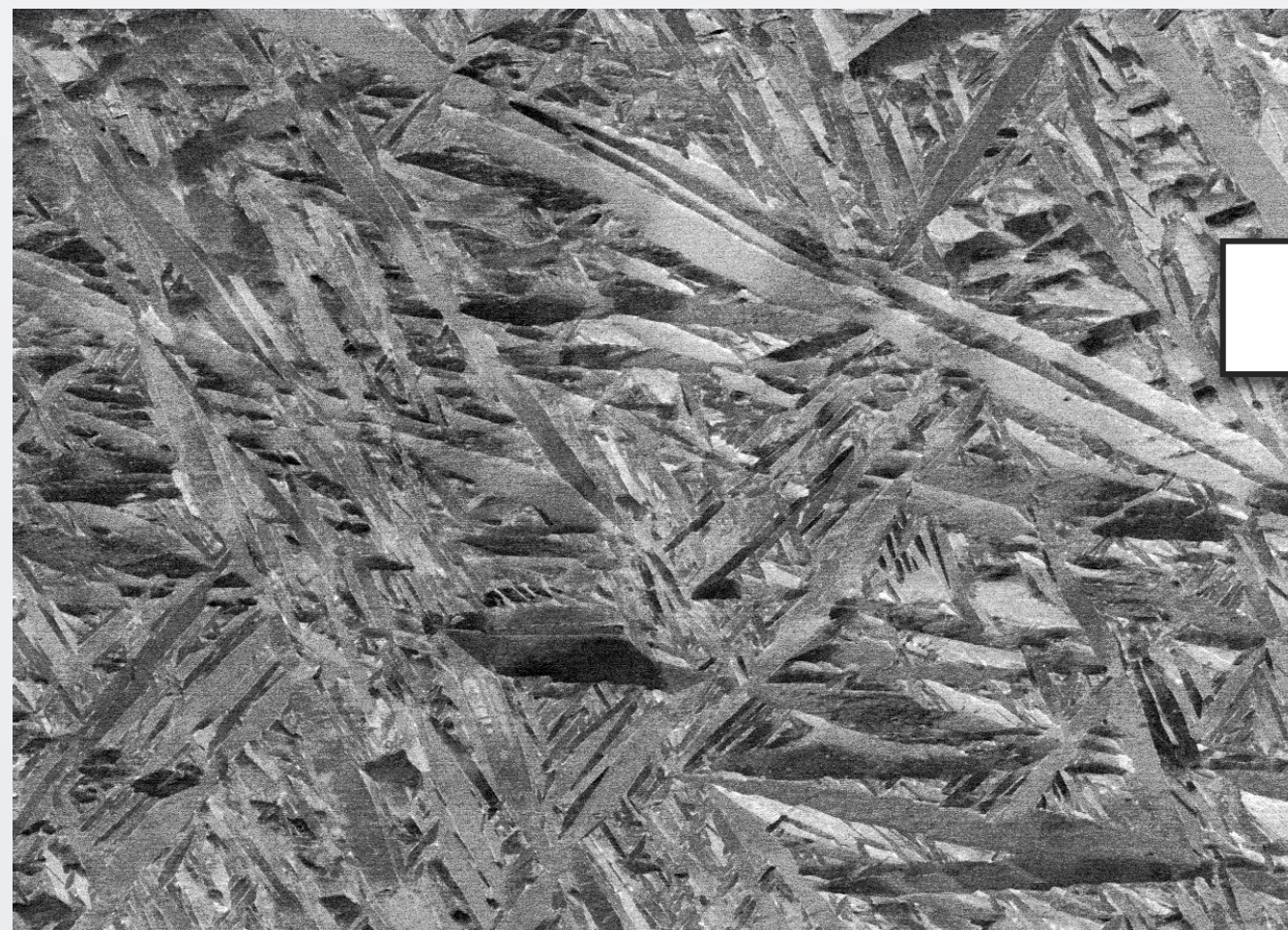
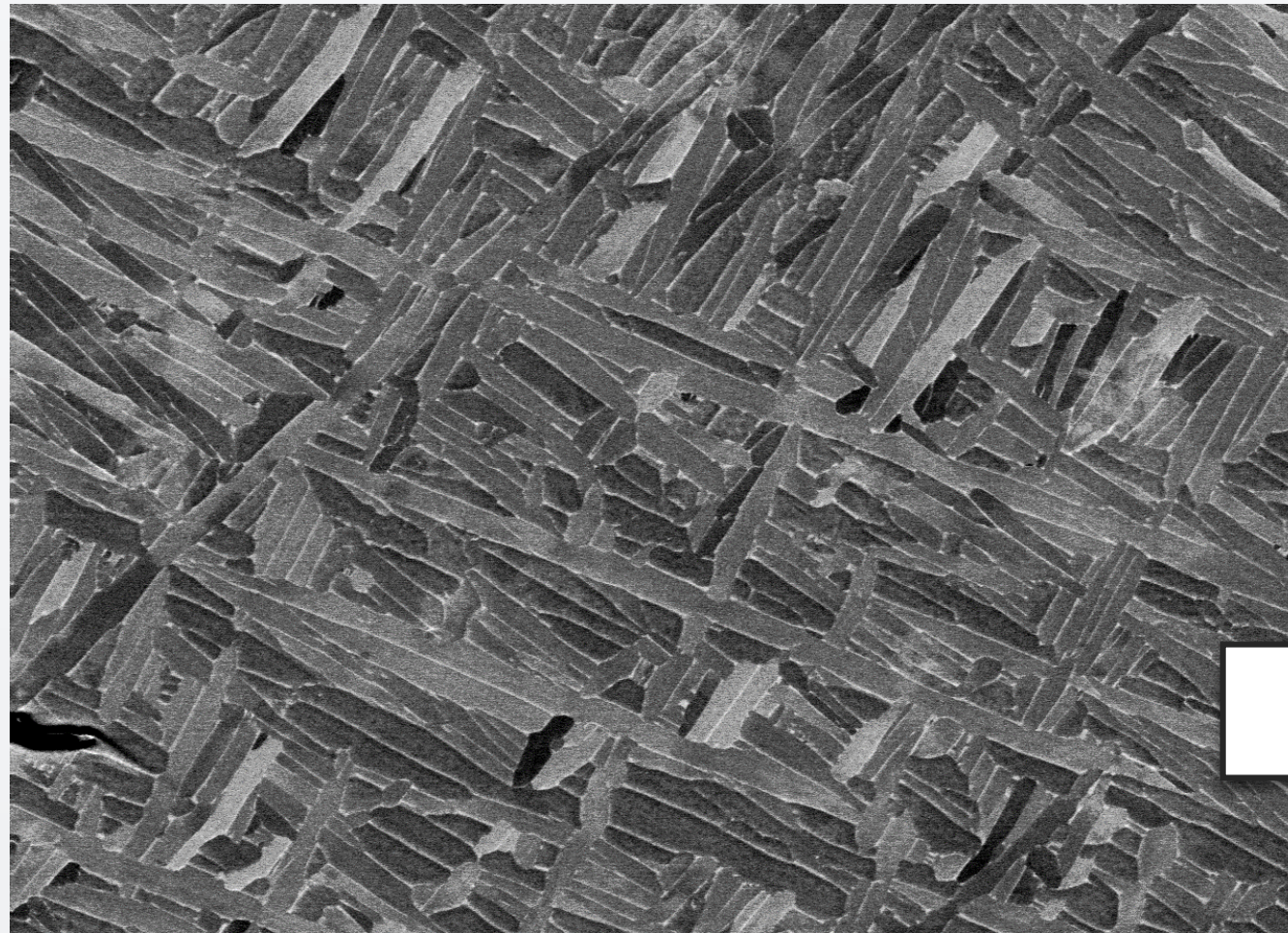
Globular

Laths

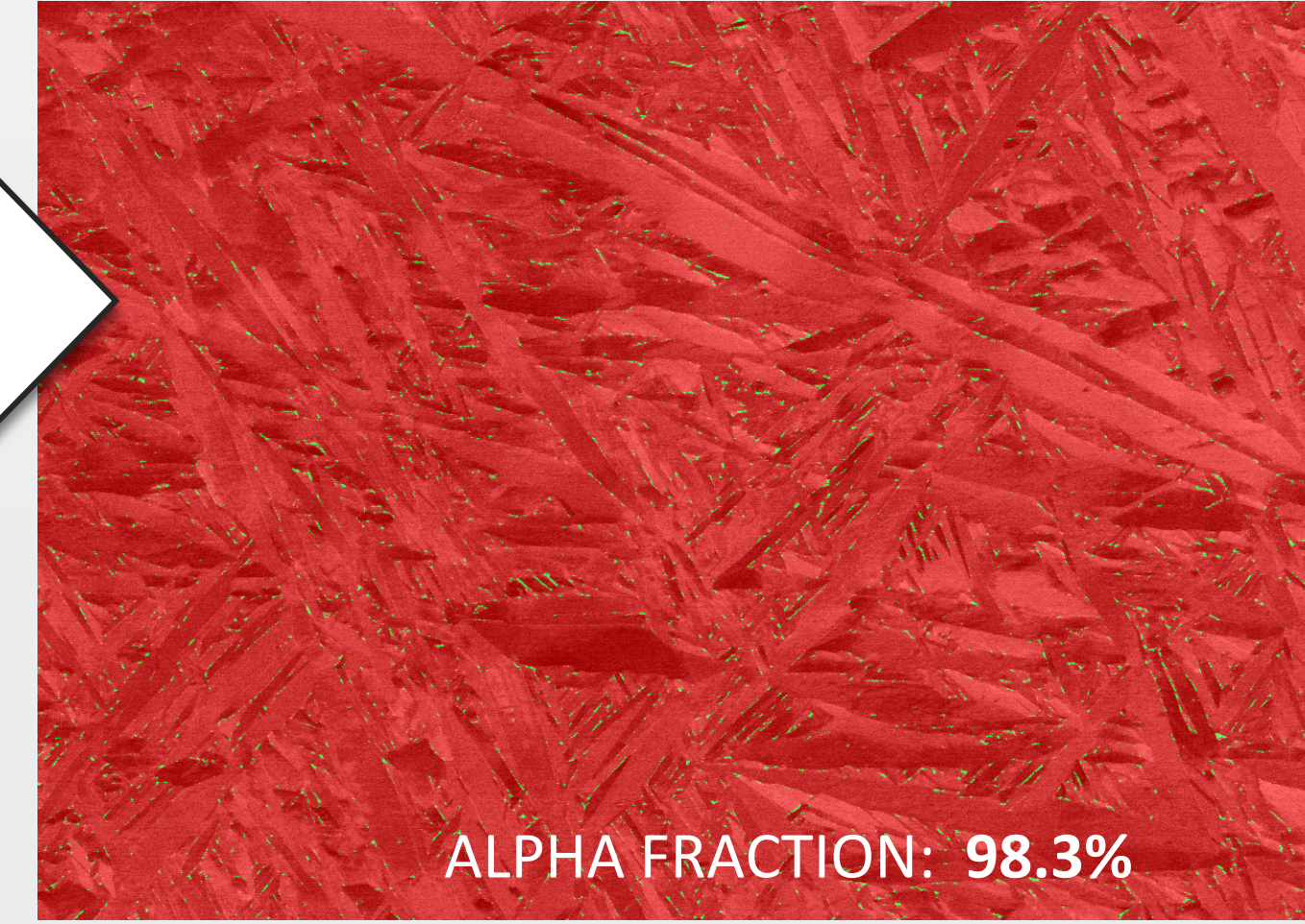
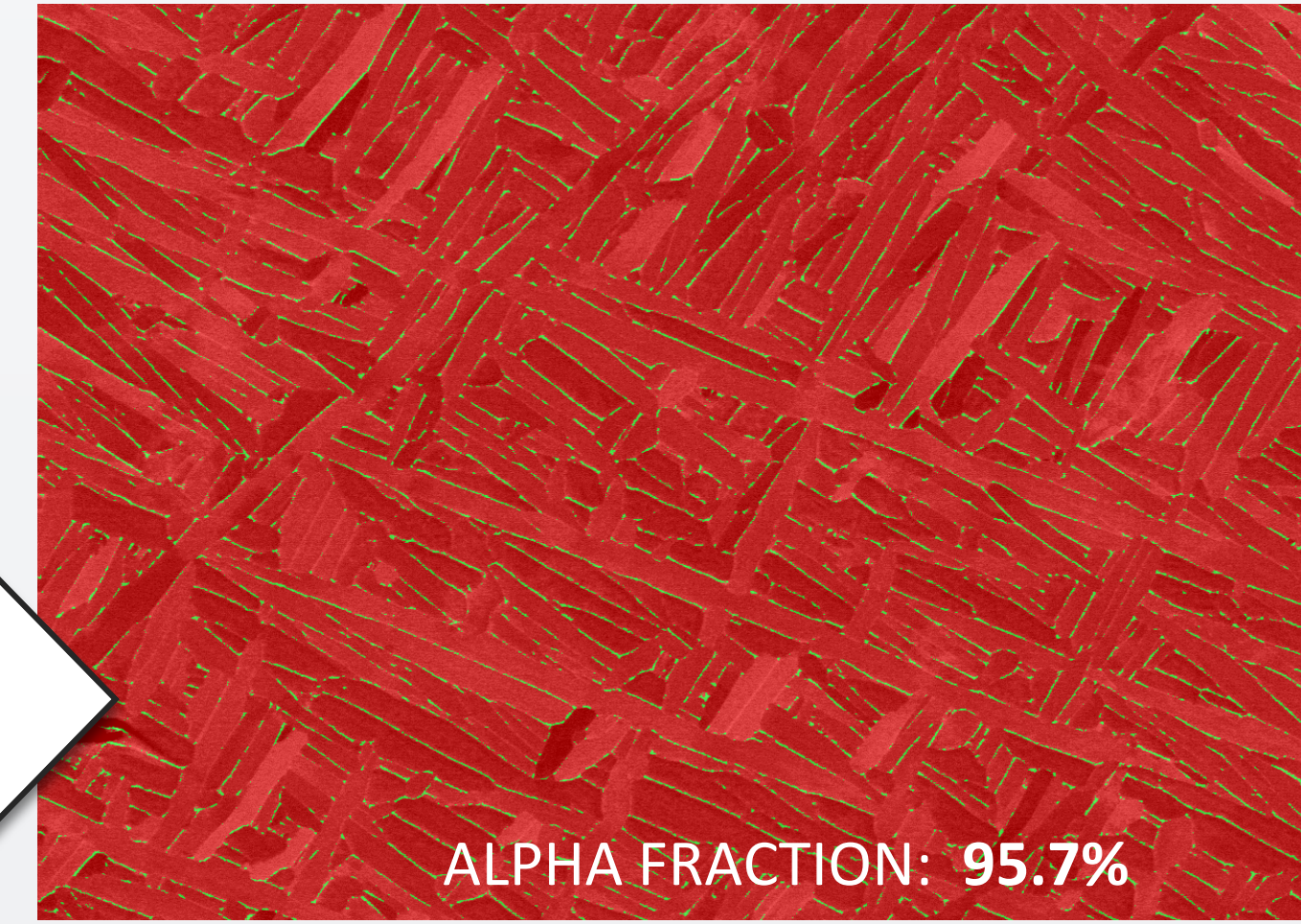
Colonies

GB Alpha

Grains



Deep
Learning
Model
#2



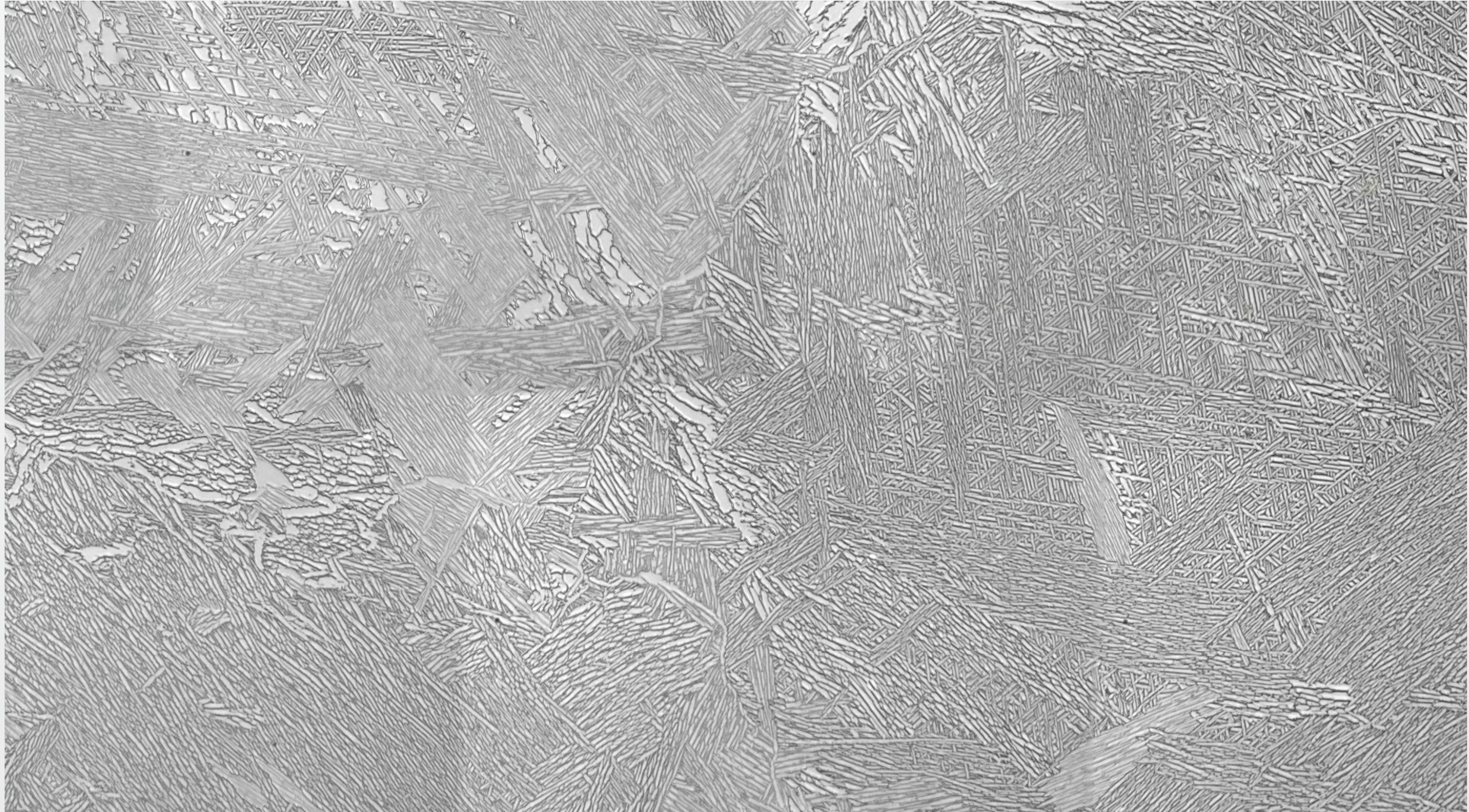
Identical algorithm accurately detects alpha/beta phases



Phase fraction measurements possible

Colony Alpha: Colony vs. Basketweave Percentage

Original Image



Globular

Laths

Colonies

GB Alpha

Grains

Colony Alpha: Colony vs. Basketweave Percentage

Deep Learning Applied

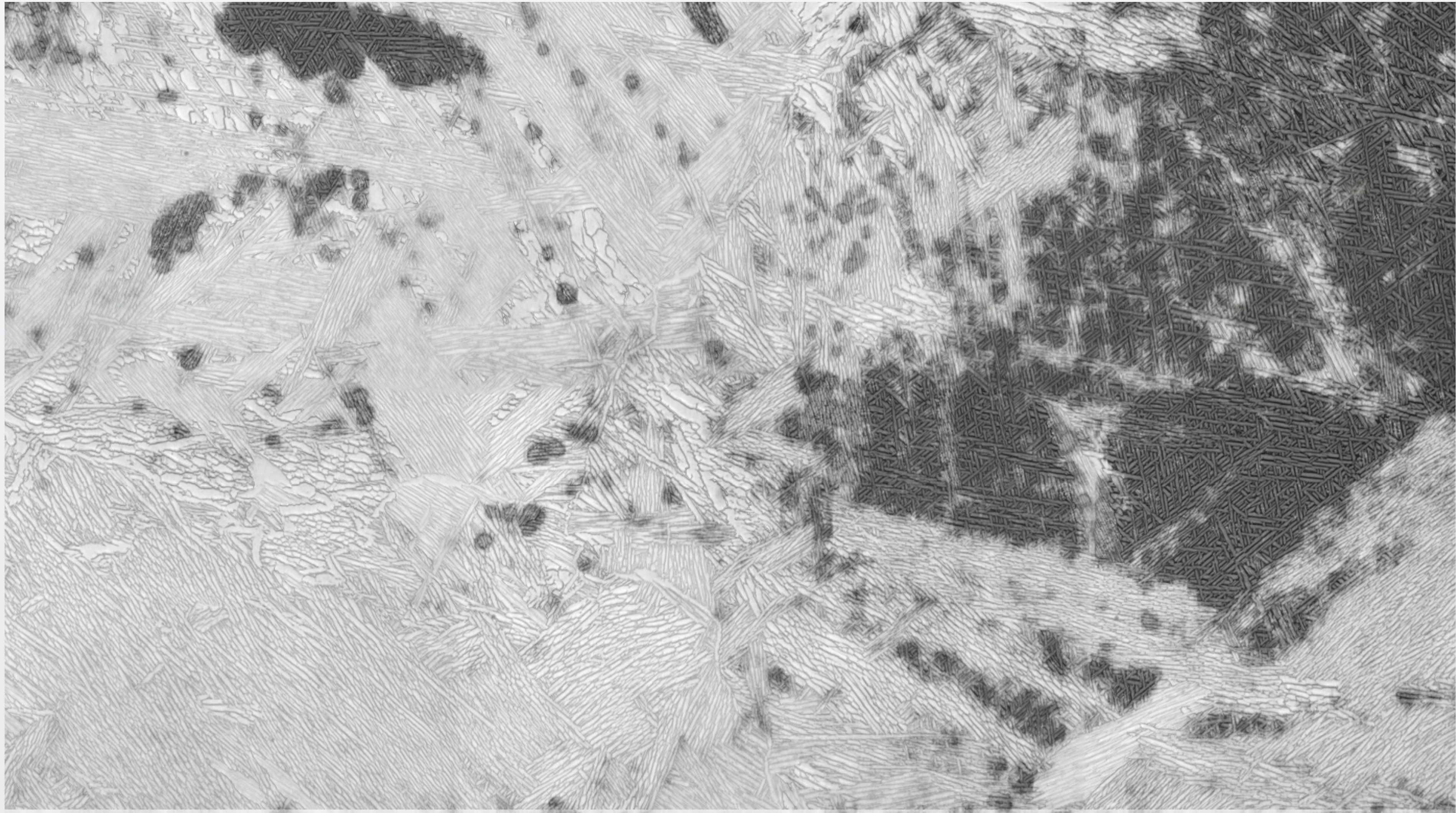
Globular

Laths

Colonies

GB Alpha

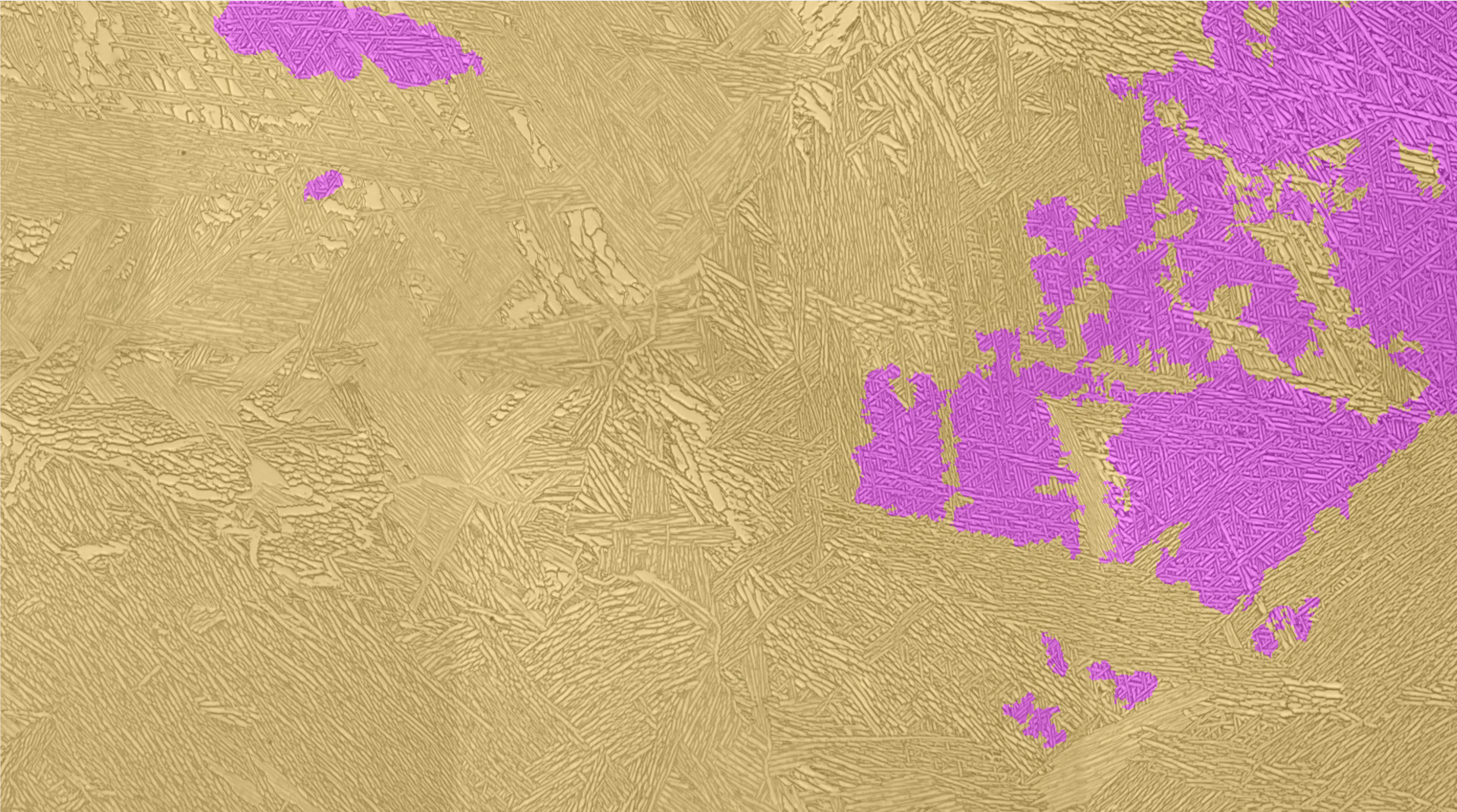
Grains



Bright areas = Likely colony

Colony Alpha: Colony vs. Basketweave Percentage

Segmentation



BASKETWEAVE

COLONY



Deep learning enables highly complex classification

BASKETWEAVE FRACTION: 15%

Globular

Laths

Colonies

GB Alpha

Grains

Colony Alpha: Colony Orientation and Size

Globular

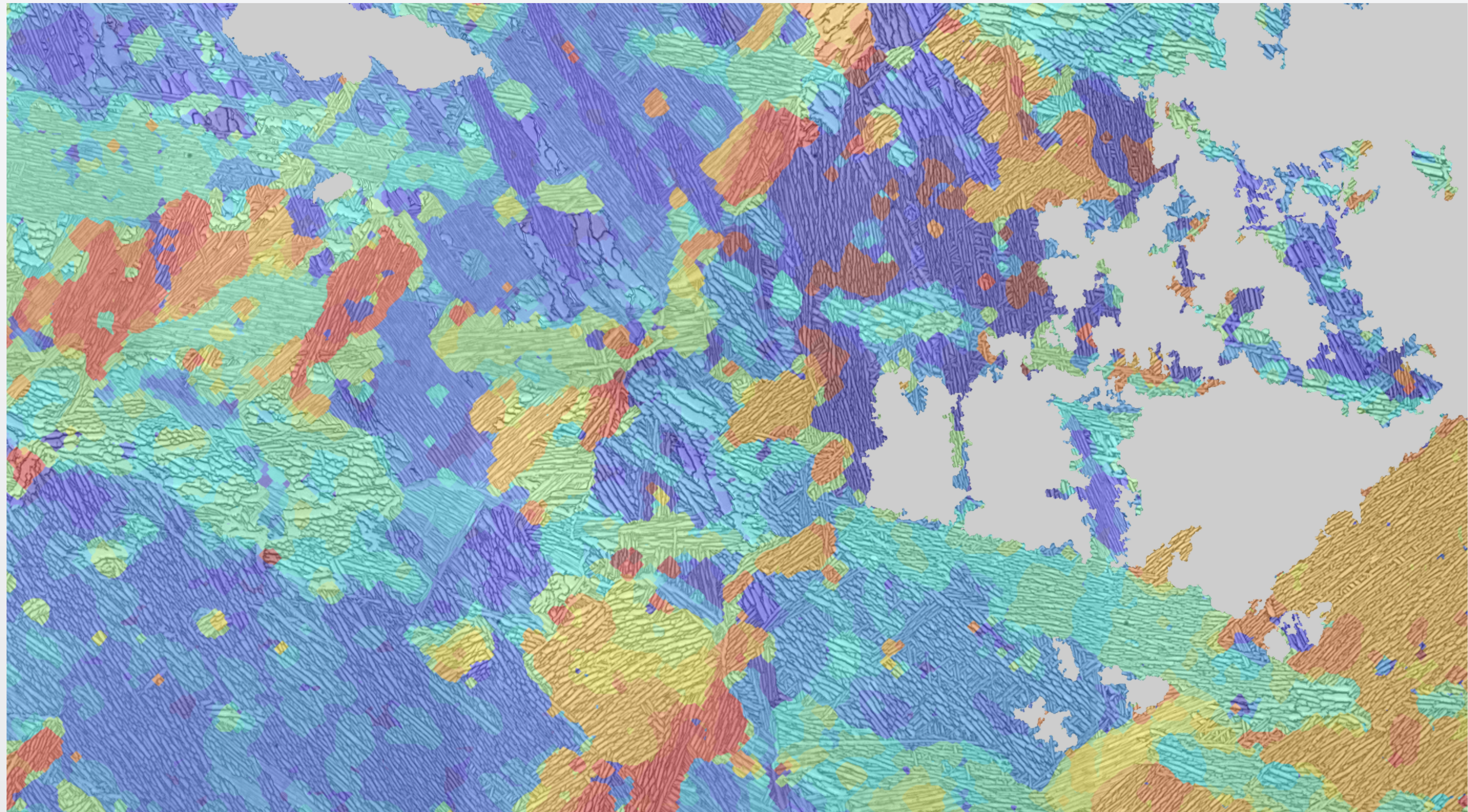
Laths

Colonies

GB Alpha

Grains

Orientation Map



Angle (°)

80

60

40

20

0

-20

-40

-60

-80



Pattern Mapping enables colony orientation quantification and size

Grain Boundary Alpha: Percentage and Thickness

Globular

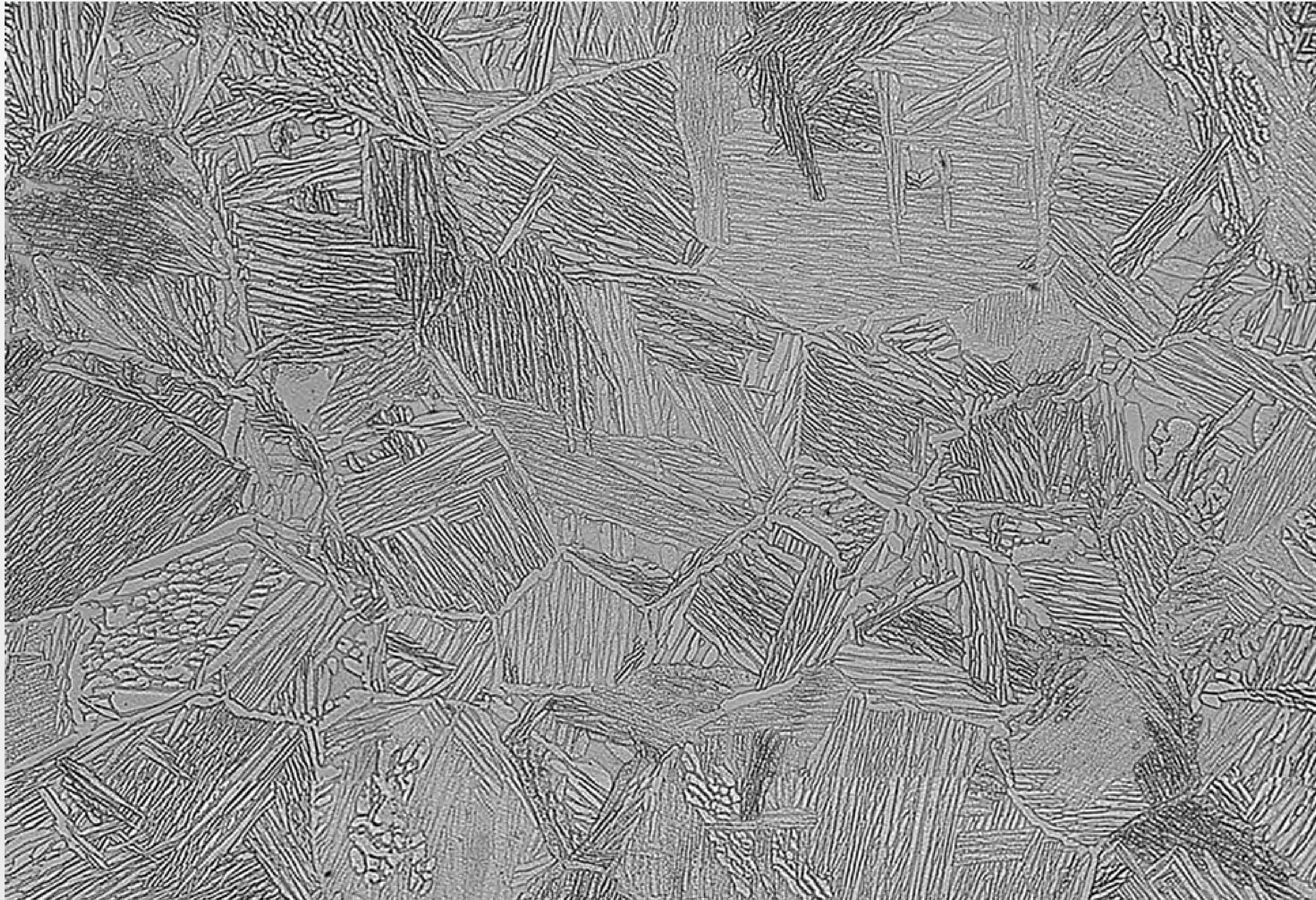
Laths

Colonies

GB Alpha

Grains

Original Image



Grain Boundary Alpha: Percentage and Thickness

Globular

Laths

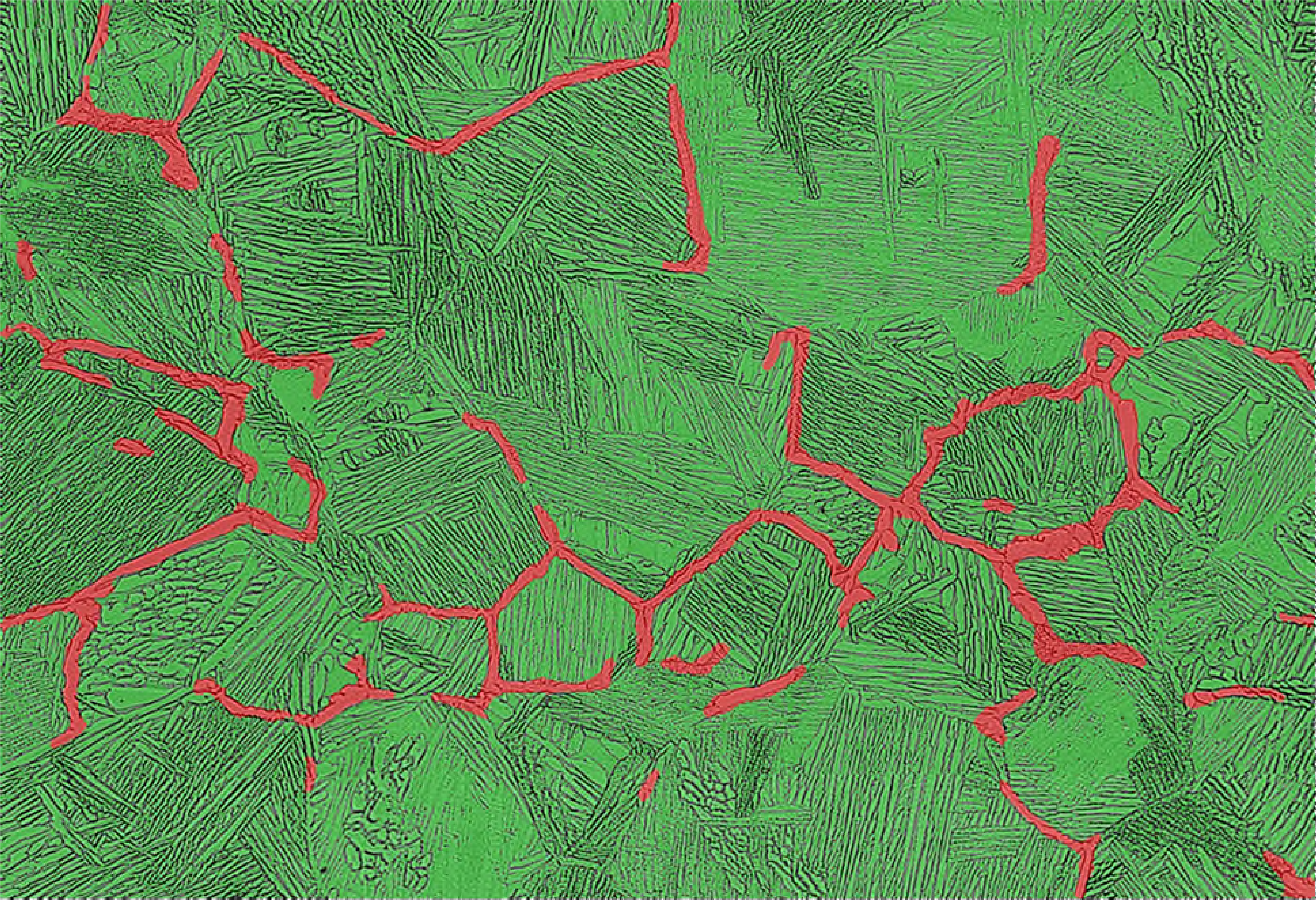
Colonies

GB Alpha

Grains

GB Alpha Detected

GB ALPHA FRACTION: 8%



Grain Boundary Alpha: Percentage and Thickness

Globular

Laths

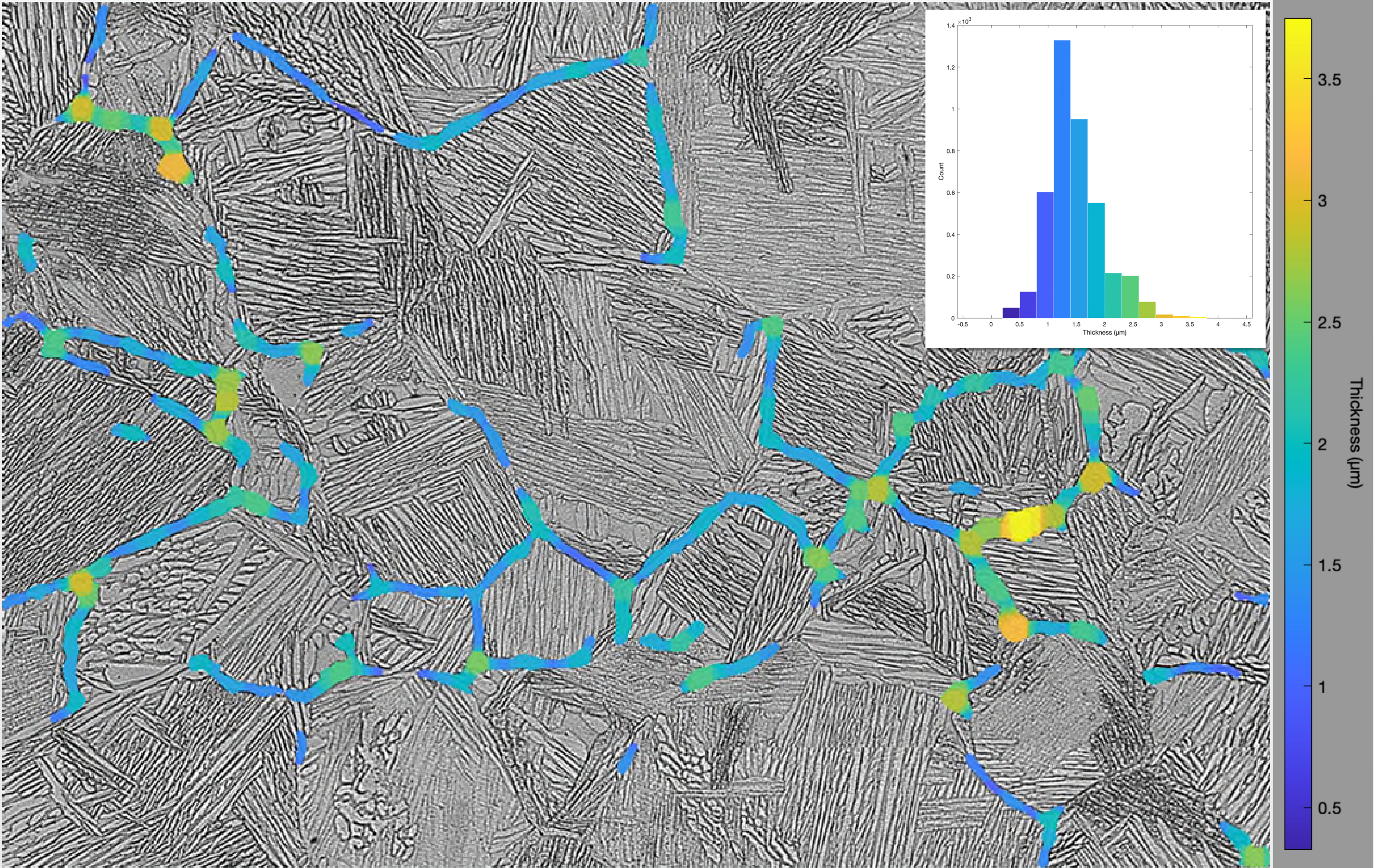
Colonies

GB Alpha

Grains

GB Alpha Thickness

MEAN THICKNESS: 1.5 μm



Beta Grains: Size

Globular

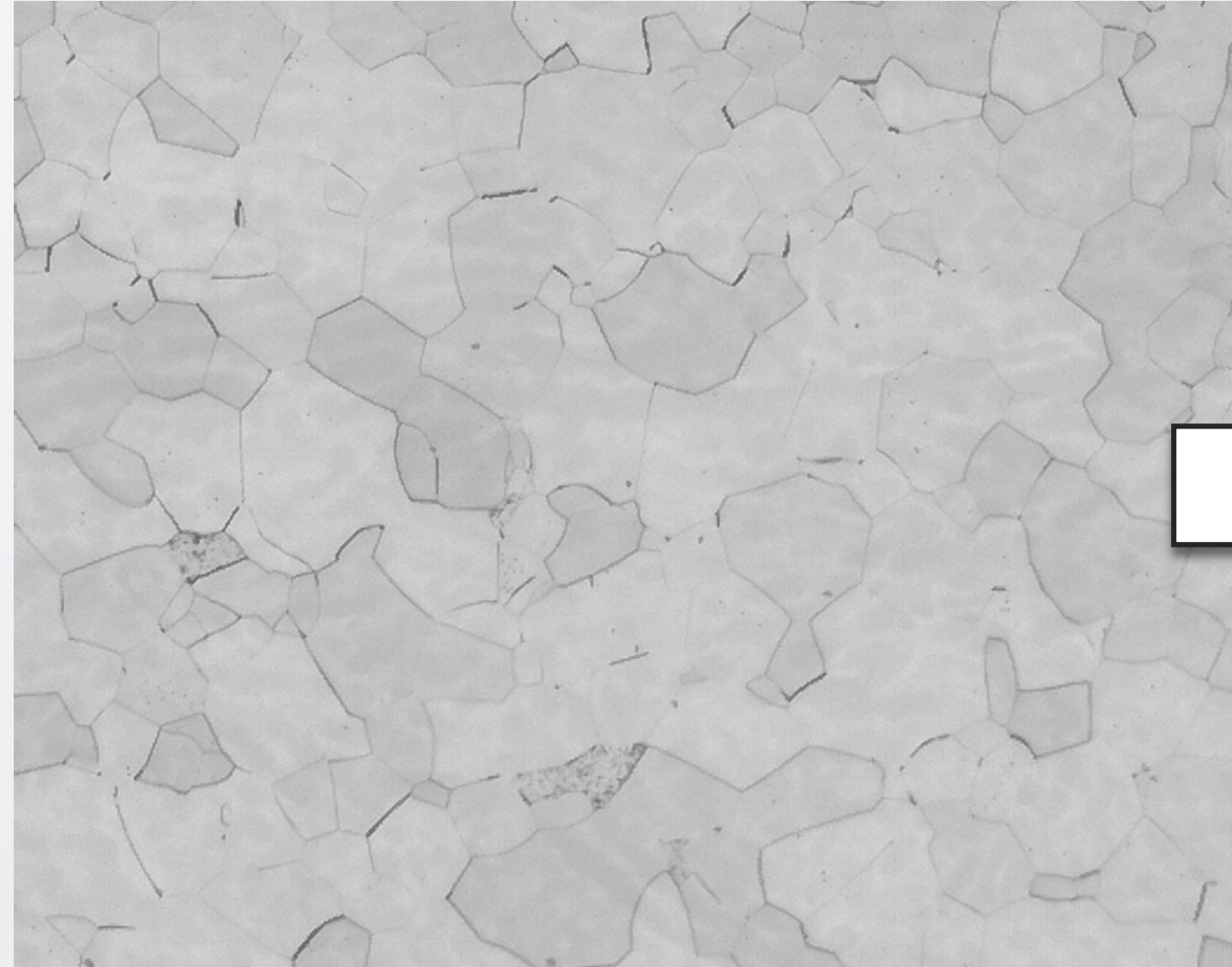
Laths

Colonies

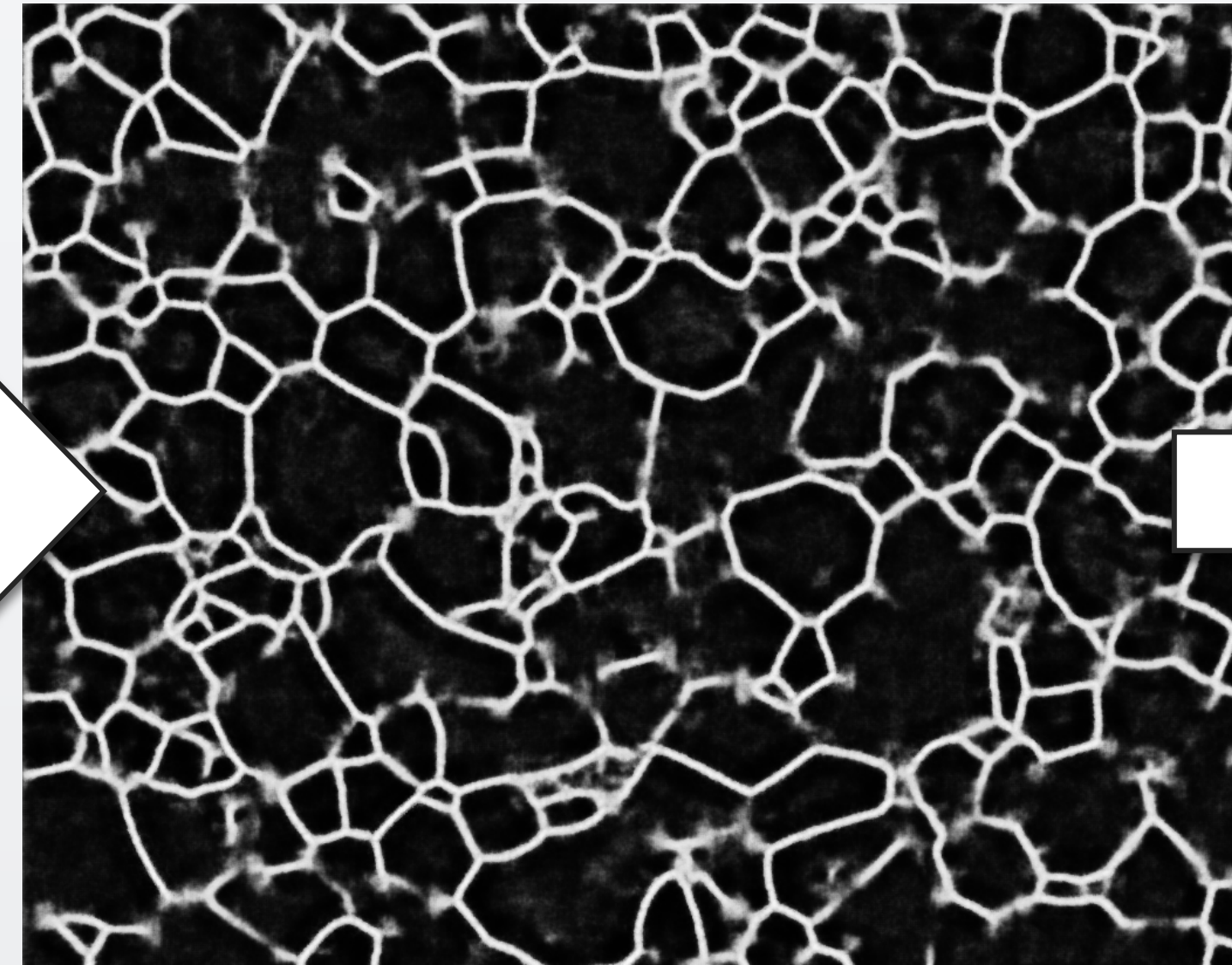
GB Alpha

Grains

Original Image



Deep Learning Applied



Final Segmentation



Accurately detects beta grains despite very faint contrast



Grain mean size and distribution measurements possible

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