

# Improving an Automated TEM Particle Analysis Workflow via Machine Learning

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## **Abstract**

Precipitate-strengthened AA 7050 aluminum alloys are widely used in aerospace applications, but show a loss in mechanical strength when exposed to high temperature processes. Researchers have observed via transmission electron microscopy (TEM) that an increase in rod-like precipitates in the alloy, which propagate when it is exposed to prolonged heat treatment, may be related to this decrease in strength. These rod-like precipitates, defined as  $\eta$  precipitates, evolve from the sphere-like  $\eta'$  precipitates during heat treatment, but both types appear in the final alloy. Further investigation into the mechanism of this loss in strength may be improved if the number and distribution of the  $\eta$  precipitates alone could be quantified during TEM particle analysis. To this end, recent software packages such as Thermo Fisher Scientific's Automated Particle Workflow (APW) allow microscopists to use automated particle analysis with a low barrier to entry due to a user-friendly interface, acquiring a large amount of particle data while reducing hands-on instrument time. However, in cases such as the AA 7050 sample, the  $\eta$  precipitates cannot be easily separated from the  $\eta'$  precipitates using straightforward image processing techniques such as thresholding—the particles are overlapping and indistinguishable via elemental composition. The deep learning module of APW allows one to “train” the software to recognize and isolate distinct particles, meaning the rod-like  $\eta$  precipitates can be targeted for analysis.

## **Biography of Presenter**

Jillian Cramer is a research associate at the University of Kentucky's Electron Microscopy Center (EMC), training users in transmission electron microscopy (TEM) and applying new characterization and data analysis techniques for the center. Her Master's at the University of Oregon in Semiconductor Device Processing was followed by a year-long industry internship in TEM Applications Development at Thermo Fisher Scientific in Hillsboro, OR. At Thermo Fisher, Jillian specialized in optimizing automated TEM software for semiconductor industry applications - a skill that she is now applying to the wide variety of samples that come through the EMC.

