Atom Probe Tomography of Perovskite Capacitors

Katherine Rice, Applications & Market Development Manager at CAMECA,
and Severin Jakob, Postdoc researcher, Institute of Thermomechanics at Czech Academy of Sciences , January 20th 2026

Context

Multilayer ceramic capacitors (MLCC) are used in almost all modern electronics. Their function is to stabilize power inputs/outflows occurring within the circuits. The structure and chemistry of these tiny capacitors has a large impact on their function. In this webinar, we investigate off-the-shelf MLCCs, outlining specimen preparation protocols to obtain electrode/capacitor interfaces, and characterizing the grain boundary segregation and phase composition.

Technical Challenge

- Typically, BaTiO3 and related perovskites have been challenging to obtain high analysis yields. Deep UV Lasers have mitigated this challenge; one explanation is that an alternate field evaporation process is occurring based on photoionization. For more see:
- Jakob S, Poplawsky JD, Jelinek AS, Mayweg D, Thuvander M. Potential role of hole accumulation via photoionization and electron tunneling during laser-assisted field evaporation of insulators with high energy photons. Phys Rev B. 2025 Oct 20;112(16):165425.

What can APT do for this application?

- APT can investigate the dopant distribution and concentrations of particular phases. In this case, rare earth Dy was found to form ~20 nm shells. Rare earths such as Dy modify the Curie temperature, bringing it in line with typical electronics operating temperatures and making BaTiO3 more effective
- The interface between the Ni and BaTiO3 was obtained, showing diffusion of Ni along grain boundaries which may have negative effects to the capacitor
- Newer technology such as scripted acquisition and simultaneous voltage pulsing have positive effects for MLCC analysis

QUICK TIPS

Preparing a specimen in cross-section (90 ° rotation) can help obtain interfaces when the sample has a stacked structure