TRANSITION TO PARTIAL ELECTRONIC CONDUCTIVITY AT THE ONSET OF FLASH MEASURED BY IN-SITU IMPEDANCE SPECTROSCOPY

Seohyeon Jo, University of Colorado Boulder
seohyeon.jo@colorado.edu
Rishi Raj, University of Colorado Boulder

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We show that the early onset of Flash in single crystals of cubic zirconia is accompanied by a transition to electronic conductivity. The transition is measured just before, during and just after the cusp of the onset. The finding has the following significant implications:

(i) The metal-ceramic electrodes, which are blocking to electrical transport of ions, which necessitates redox reactions of the type $O + 2e \rightarrow O_2^-$, yield to becoming non-blocking since the electrons can be transported via the external circuit to maintain high overall conductivity.

(ii) The blackening and abnormal grain growth seen near the electrodes most likely occur before the onset of the flash.

(iii) The ideal transport number to avoid (ii) should be approximately 0.5. We are seeking to measure it in our laboratory.

(iv) The onset of electronic conductivity implies the generation of electrons and holes, which can recombine to produce electroluminescence.

Figure 1 – Nyquist plot of 8YSZ single crystal at near the flash temperature when applied electric field.