

The Good, The Bad and the Ugly: A Tale of Microscale Corrosion

The study of grain-dependent corrosion behaviors of practical polycrystalline metals remains challenging due to the difficulty in eliminating the influences of other microstructural features, such as intermetallic particles and grain boundaries. In this talk, we performed thousands of microscopic potentiodynamic polarization measurements on a polycrystalline aluminum alloy AA7075-T73 using the spatially resolved oil-immersed scanning electrochemical cell microscopy measurement. Data were extracted only from grain interior areas excluding intermetallic particles and grain boundaries. Based on the multiple potentiodynamic polarization measurements, the differences between grains can be revealed. Cathodic currents exhibited a strong grain orientation dependence with a decreasing order of $\{101\} > \{001\} > \{111\}$, agreeing with the prediction from the order of atomic planar density. By contrast, the dependence of anodic currents on grain orientation was weak, and pitting was independent of grain orientation, which could be due to the limited mass transport of ions within the surface oxide film. This work highlights the capability of oil-immersed scanning electrochemical cell microscopy in resolving small electrochemical differences, which will greatly promote the study of grain-dependent behaviors of practical polycrystalline samples.