Objective:
Previous literature studies [2] have shown a lack of understanding how to control infiltrated Solid Oxide Fuel Cell (SOFC) nano-particle sizes, with smaller particle sizes improving performance.

Our group has found two fabrication techniques, desiccation and pre-infiltration, can tailor infiltrated SOFC nano-particle sizes using Triton X-100 (TXD) as a surfactant.

Literature studies [2] have not provided a detailed comparison of the effects of different surfactants on nano-particle size. The goal of this work is to investigate the effects, Citric Acid (CAD) and TXD, on particle size and performance.

Modeling:

Simple Infiltrated Microstructure
Polarization Loss Estimation
(SIMPLE) Model

\[
\Delta \rho = \frac{R_{\text{IEC)}}}{\sigma_{\text{IEC}}} \left[ \frac{1 - \rho}{1 - \rho \exp \left( \frac{-E_{\text{a}}}{RT} \right)} \right]
\]

\[
\alpha = \frac{\sigma_{\text{IEC}} r (1 - \rho)}{A_{\text{IEC}}} \frac{R_{\text{IEC}}}{A_{\text{IEC}}}
\]

- \( R_{\text{IEC}} \) — Overall Polarization Resistance
- \( R_{\text{IEC}} \) — IEC Intrinsic Surface Resistance
- \( A_{\text{IEC}} \) — IEC Surface Area
- \( \sigma_{\text{IEC}} \) — IEC Conductivity
- \( r \) — Repeat Unit Thickness
- \( h \) — Ionic Conductor Thickness
- \( p \) — Porosity

The SIMPLE Model Predicts the Lowest Possible Polarization Resistance at a Specific Temperature

The SIMPLE Model only takes into account surface oxygen exchange resistance and bulk ionic transport resistance.

The SIMPLE Model is depicted as a dotted line on each performance plot to show modeled performance changes based on particle sizes.

References:
[1] Nicholas et al., PCCP, 14, 15379 (2012)