Understanding performance degradation in SOFCs requires an understanding of electrode microstructure. Prior methods yield small fields of view below scale of heterogeneity present in some cells. Nanoscale X-ray CT can yield 3D microstructure of a larger volume. Here, we present imaging, artifact removal, and analysis of the scale of heterogeneity in industrial SOFC electrodes.

**Abstract**

- Understanding performance degradation in SOFCs requires an understanding of electrode microstructure.
- Prior methods yield small fields of view below scale of heterogeneity present in some cells.
- Nanoscale X-ray CT can yield 3D microstructure of a larger volume.

**Three-Phase Artifact**

- **Raw Virtual 2D slice**
  - Segmentation
  - Void (continuous)
  - LSM
  - YSZ
  - Void (discontinuous)
- Artifact: LSM-YSZ interface

**Removal Method: Morphological Dilation**

- **Dilation:**
  - Different kernels and sizes
  - Void removal by sequential dilation
  - Void + LSM + YSZ

**Ongoing Work: Advanced Sample Prep for Larger, More Representative Samples**

- **Cut-and-polish method**
  - Cut
  - Polish
  - Trim with laser
  - Extract pillar

**Using a Spherical Dilating Kernel of R = 2:**

- **3D Spatial Analysis of TPB Distribution**
  - TPBs determined vertex-by-vertex in 3D
  - Vertices connected to orthogonal neighbors
  - Paths smoothed for accurate length measurement
  - Local TPB length stored on voxel-by-voxel basis for 3D spatial analysis

**Heterogeneity Analysis**

- Multiple cubic ROIs placed within larger volume
- How much does TPB density differ between each cube, as the cubes become smaller?

**Analysis of larger cathode volume (45 x 32 x 25 μm)**

- Virtual 2D slice from 3D image
- Phase fraction analysis
- Phase connectivity analysis

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