

Rapid flash-lamp sintering as alternative to traditional thermal sintering

(A potential semester project, preferably for students with a background or interest in material science)

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Photonic curing or rapid flash-lamp sintering is a contactless light-based heating technique, in which a Xenon flash lamp produces a rapid pulsed light, within micro to milliseconds time frame, and heats up the substrate up to a few hundred degrees. The working concept is based on the light absorption in thin films and electron excitation from valence to conduction band. Electrons with energies larger than the conduction band edge release their extra energy to fill the available band states near the conduction band edge. The excess energy is released as phonons and leads to localized heating of the material. So, the generated thermal energy is a result of the absorbed light. This technique is utilized to achieve rapid sintering of the films and has mainly been used in electronic application. The application of using flash lamp for high-temperature sintering is relatively new and challenging, as densification is needed.

The goal of this project is to achieve a dense, uniform microstructure of the Solid Oxide Cell (SOC) ceramic electrode after sintering using a rapid and contactless Xe flash lamp. The cathode ink is screen printed on SOC cells, and sintered using a Xe flash lamp. Flash modification is needed to achieve a dense and defect-free microstructure after sintering. After sintering, the samples are characterized in terms of microstructure (using SEM), phase analysis (using XRD) and oxidation states (using XPS) and are compared with traditional thermal sintering. The methodology is shown schematically in Figure 1.

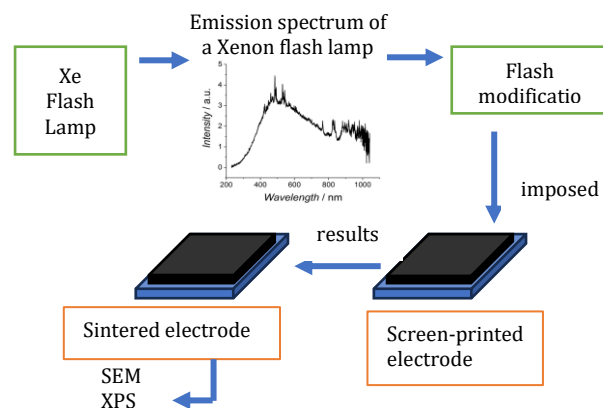


Figure 1. Schematic of Xe flash lamp sintering of screen-printed air electrode

This project will begin with a literature review on ceramic sintering using rapid sintering methods and the challenges regarding such techniques. In the experimental part, the student will receive training in cathode screen printing and sintering methods, and will also be responsible for analyzing and interpreting the characterization results. The student will receive supervision throughout all steps of the project.