# Synthesis of cathode materials for solid oxide fuel cells with eggshell membrane as template

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Solid oxide fuel cells (SOFCs) are promising power generation devices because of their high energy conversion efficiency, and the cell performances greatly depend on the starting materials used in the fabrication of SOFCs. Perovskite ceramics are extensively used in solid oxide fuel cells. However, perovskite ceramics need a higher crystallization temperature than single metal oxides and bimetal oxides, and their properties depend on ceramics crystalline and morphology. At present, perovskite materials are mainly synthesized by either solid state reaction or wet-chemical synthesis (e.g. gel combustion), but both methods produce aggregated particles after high temperature crystallization. Template synthesis is an effective way to control ceramic morphology, and bio-templates such as butterfly wing and eggshell membrane (ESM) are particularly attractive for synthesizing metal oxide ceramics because of strong metal-protein bonding. ESM is a cheap and easily available biomaterial with an interwoven fibrous structure. Unlike the ceramics synthesized by other templates, the ESM-templated ceramics could tolerate high temperatures owing to the interwoven fibrous structure.

In this study, we employed ESM as a bio-template to synthesize perovskite $Sm_{0.5}Sr_{0.5}CoO_3$ (SSC) ceramic. The perovskite material was crystallized at 1000 °C, and the interwoven fibrous structure was replicated, as shown in Fig.1.

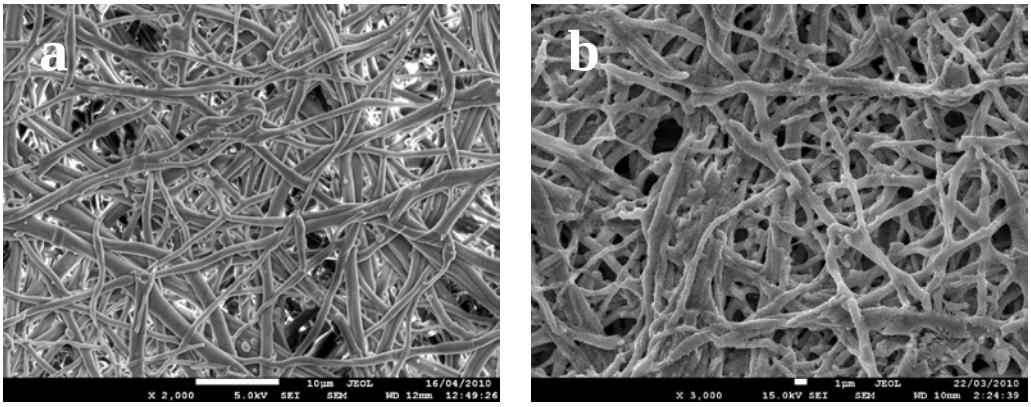
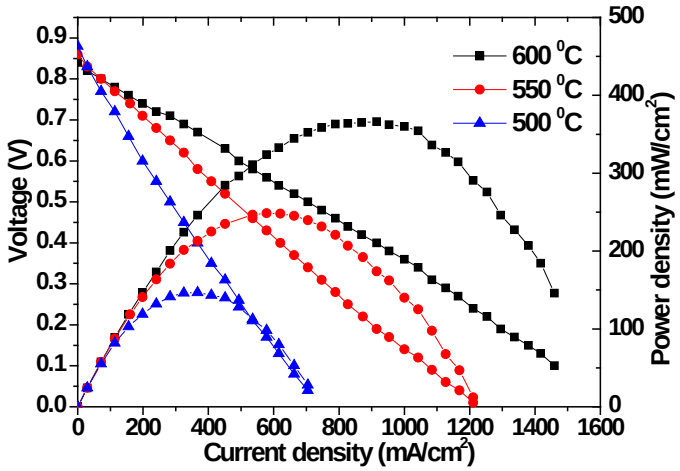



Fig.1. SEM images of (a) ESM and (b) ESM templated SSC ceramic

Even though the as-synthesized high porosity ceramic can not be used as the cathode directly due to high shrinkage during crystallization, the interwoven fibrous ceramic can be readily ground into well-dispersed miro-sized particles. The high crystalline

$Sm_{0.5}Sr_{0.5}CoO_3$ (SSC) particles were then characterized as a starting material of cathode. The cathode layer had high porosity and surface area, which were good for the transfer of oxygen and producing more electrochemical active sites. Finally, the SOFC made with bio-templated SSC exhibited a maximum power densities of 366mW/cm$^2$ at 600°C and 248mW/cm$^2$ at 550°C operated with $H_2$/air (see Fig.2). Therefore, bio-template synthesis is a facile and effective way to synthesize perovskite ceramics with high quality for SOFC application.

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