LOW TEMPERATURE TECHNOLOGIES FOR SOFCs

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In the past years considerable progress has been made in the improvements of SOFC design [1-4]. This success results from an improved understanding of the physical processes of SOFC operation. In particular, the importance of the reaction (or adjacent) interlayers has been clearly recognized [2]. It has been shown that efficient SOFCs can be made using powder based technologies (such as tape casting and screen printing), if proper interfacial interlayers are used on both the anode and cathode sides. There is no doubt, that powder based technologies will be the basis for the future industrial SOFC fabrication since they represent the potential of producing SOFCs which are both economical as well as robust.

However, powder based technologies do have some limitations, and it is impossible to optimize SOFC design using only these technologies. In particular, high temperature processes are required to fabricate the cells. This causes problems for cathode and anode supported SOFC, because high temperature co-sintering (more than 1300^{o}C) needs to be used to densify the electrolyte. Chemical reactions can take place between electrolyte and electrodes which limits the number of the materials involved (especially for cathode supported design). In addition, mismatch in the shrinkage and thermal expansion can impact mechanical integrity of the system.

The use of reaction interlayers tends to lessen these problems. The properties of reaction interlayers can not be optimized using only powder based technologies, because final grain size will be defined by the annealing temperate and can not be controlled. High temperature annealing helps to ensure high conductivity, but it will cause decreased effective surface area in the reaction interlayers and suppress gas exchange properties. These are the reasons why the search of alternative technologies is important.

The objective of this investigation was to add more flexibility in the powder based technologies using metal-organic polymers as a binder. It was shown earlier that metal-organic polymers can provide dense, conductive ceramic layers at very low temperature (such as 700^{o}C), so they have a potential to be an effective element in these technologies [5-7].

A composite based on YSZ was prepared by combining the powder and metal-organic polymer. It was shown, that preparation temperature can be lowered up to 400^{o}C and is limited only by the polymer decomposition. It is possible to prepare YSZ layers with high ionic conductivity and controlled porosity (from very porous up to dense material) using this technique, so composite materials can be effectively used for electrolyte deposition as well as for cathode and anode interlayers and any reactions between SOFC components can be minimized.

References

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