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Continuous Hydrothermal Flow Synthesis of Functional Oxide Nanomaterials for Energy Conversion Devices

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The application of continuous hydrothermal flow synthesis (CHFS) to preparing oxide nanomaterials with tailored properties has gained increasing attentions, due to its availability to a large-scale production of nanomaterials that are indispensable in many modern technology applications.[1]

The presentation will be based on results of a three-year PhD project, in which CHFS was used to develop several types of oxides that are of interest to researches on solid oxide cells, oxygen permeation membranes and catalysis.

First a dual-stage flow-type reactor will be introduced that can work in either single-stage (for synthesis of single-phase materials) or dual-stage (for synthesis of nanocomposites) mode.[2] Results on syntheses and characterizations of $Y_xZr_{1-x}O_{2-\delta}$ (YSZ), NiO, $Gd_xCe_{1-x}O_{2-\delta}$ (GDC), $LaCrO_3$ and $Ni_xCo_{1-x}Fe_2O_4$ nanoparticles will be presented, showing a wide applicability of the CHFS technique. Further, some primary endeavors with respect to applications of synthesized nanomaterials will be presented. For instance, slurries of YSZ and NiO nanocomposites were tape casted for making fuel electrodes. Suspension of synthesized GDC nanoparticles was transferred to inks modified for inkjet printing of electrolyte films. $Ni_xCo_{1-x}Fe_2O_4$ was used as catalyst that was evaluated in the CO oxidation process and in the electrochemical oxygen evolution reaction for water splitting.

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