Strontium Titanate Perovskite Based Electrode Materials for Solid Oxide Membrane Reactors

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Oxygen is a major component of many catalytic reactions, including, fuel cells, energy-related applications, emission control, and chemical synthesis. Control of selectivity for any chemical reaction is a challenge, and oxygen is known to have a major impact of selectivity of many oxygen containing reactions. Besides the amount of oxygen, oxygen species available also affect the selectivity of the reaction. Solid Oxide Membrane Reactors consisting of an oxide ion conducting electrolyte and two electrodes (anode and cathode) can help improve the selectivity for oxygen containing catalytic reactions, by controlling amount of oxygen available for the reaction. Moreover, tailoring the properties of electrode catalysts, oxygen species on the surface and the selectivity can be controlled.

Strontium titanate type perovskites were tested as electrode materials for these reactors and they were tested for oxidative dehydrogenation of ethane to ethylene and CO_2 & H_2O reduction reactions [1, 2, 3]. The effect of lanthanum doping and chlorine incorporation on these catalysts was investigated. The characteristics of the catalysts were investigated using ambient and in-situ X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), diffuse reflectance infrared spectroscopy (DRIFTS), temperature programmed oxidation (TPO) and electronic conductivity measurements. Besides Electro-ODH experiments to test the activities, impedance measurements were also taken using to better understand the cell characteristics and resistances. Oxygen flux measurements were also performed.

References:

1) Doruk Dogu, Katja E. Meyer, Anshuman Fuller, Seval Gunduz, Dhruba Jyoti Deka, Nathaniel Kramer, Anne Co and Umit S. Ozkan, “Effect of Lanthanum and Chlorine Doping on Strontium Titanates for Electrocatalytically-Assisted Oxidative Dehydrogenation of Ethane”. Applied Catalysis B: Environmental, 227:90-101 (2018)

2) Doruk Dogu, Seval Gunduz, Katja Binkley Meyer, Dhruba Jyoti Deka, Anne Co and Umit S. Ozkan., “CO_2 and H_2O Electrolysis Using Solid Oxide Electrolyzer Cell (SOEC) with La and Cl^- doped Strontium Titanate Cathode”, Catalysis Letters, 149(7):1743-1752 (2019)

3) Seval Gunduz, Doruk Dogu, Dhruba J. Deka, Katja E. Meyer, Anshuman Fuller, Anne C. Co, and Umit S. Ozkan, Application of Solid Electrolyte Cells in Ion Pump and Electrolyzer Modes to Promote Catalytic Reactions: An overview”, Catalysis Today 323:3-13 (2019)