SOL-GEL DERIVED SN-FERRITE FOR H_2 GENERATION FROM WATER-SPLITTING REACTION

R. R. Bhosale, R. P. Khadka, S. C. Quikel, R. V. Shende*, and J. A. Puszynski
Department of Chemical & Biological Engineering
South Dakota School of Mines & Technology
Rapid City, SD 57701
*rajesh.shende@sdsmt.edu

ABSTRACT

Ferrites such as $(A_xB_y)Fe_zO_4$ (doped spinel) or $(A_xB_y)Fe_{1-x-y}O$ (doped wustite) or their mixtures, where A and B are bivalent metal cations, were reported to be the most active materials for hydrogen generation using thermochemical water-splitting reactions. Although these ferrites have been synthesized by solid-state mixing, oxidation of aqueous metal hydroxide suspension, self-propagation high temperature synthesis and aerosol spray pyrolysis methods, the use of sol-gel derived ferrites for thermochemical water-splitting reactions is very limited. The sol-gel synthesis method provides better control over stoichiometry and powder characteristics. The powders produced by the sol-gel synthesis method usually have higher specific surface area, which may provide a higher number of active sites for water-splitting reactions. In this investigation, Sn-ferrite and Sn doped Ni-ferrite were synthesized using a sol-gel technique wherein Ni, Sn and Fe salts were dissolved in ethanol by sonication with the gel formation being accomplished by adding propylene oxide. The gels were aged for 48 h, dried at 100 °C for 1 h, and finally calcined at 900 °C in an air environment. The calcined powder was characterized using powder X-ray diffraction, Brauner-Emmett-Teller surface area analysis and scanning electron microscopy. After the powder was placed in a packed bed reactor, the water-splitting reaction was carried out at 700 °C. After each water-splitting reaction, oxidized ferrite was regenerated at 900 °C for 2 h in an N_2 environment. Synthesis method, characterization, and transient hydrogen profiles obtained at various experimental conditions will be presented in detail.