Development of Ceramic Interconnect Materials

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The effect of transition metal substitution on thermal and electrical properties of Ca-doped yttrium chromite was investigated as a ceramic interconnect material for solid oxide fuel cells (SOFCs). 10 at% Co, 4 at% Ni, and 1 at% Cu substitution on B-site of 20 at% Ca-doped yttrium chromite led to a close match of thermal expansion coefficient (TEC) with that of 8 mol% yttria-stabilized zirconia (YSZ), and a single phase $Y_{0.8}Ca_{0.2}Cr_{0.85}Co_{0.1}Ni_{0.04}Cu_{0.01}O_3$ remained stable between 25 and 1100^{o}C over a wide oxygen partial pressure range. Doping with Cu significantly facilitated densification of yttrium chromite. Ni dopant improved both electrical conductivity and dimensional stability in reducing environments, likely through diminishing the oxygen vacancy formation. Substitution with Co substantially enhanced electrical conductivity in oxidizing atmosphere, which was attributed to an increase in charge carrier density and hopping mobility. Electrical conductivity of $Y_{0.8}Ca_{0.2}Cr_{0.85}Co_{0.1}Ni_{0.04}Cu_{0.01}O_3$ at 900^{o}C is 57 S cm^{-1} in air and 11 S cm^{-1} in fuel (pO_2=5×10^{-17} atm) environments. Chemical compatibility of doped yttrium chromite with other cell components was verified at the processing temperatures. Constrained and co-sintering behavior of screen-printed $Y_{0.8}Ca_{0.2}Cr_{0.85}Co_{0.1}Ni_{0.04}Cu_{0.01}O_3$ was evaluated, and densification was significantly improved by addition of infiltration steps.