Mechanism and properties of core-shell metal-ceramic microstructure synthesized by hydrothermal method

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Heat and mass transfer properties of heterogeneous catalysts are important factors that play a substantial role on their performance in practical applications. However, the conventional heterogeneous catalysts are mostly constructed on ceramic substrates (Al_2O_3, SiO_2, etc.) with low thermal conductivities and high specific heat capacities.

In this study, we present a direct synthetic protocol for core-shell microstructures consisting of a highly heat conductive Al-metal core with a high surface area crystalline $MeAl_2O_4$ (Me = Mg, Co, Zn, Ni and Mn) spinel oxide shell that can collectively benefit superior heat and mass transport properties. In addition, we report studies on the formation mechanism and characteristics of the $MeAl_2O_4$@Al (Me = Zn, Ni, Co, Mn, and Mg)with an extensive experimental and theoretical investigation with various period 3–6 metal elements (Na, Ca, Sr, Ba, K, Fe, Cu, Zn, Ni, Co, Mn, and Mg).