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Platinum-Gallium (Pt-Ga) Intermetallic Alloys for Propane Dehydrogenation

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ABSTRACT

Natural gas is a source of energy for the United States. The Center for Innovative Strategic Transformation of Alkane Resources (CISTAR) plans to use shale gas extracted from shale rock formations as a bridge fuel to replace coal and oil while the US transitions to renewable energy like solar and wind. After methane, the largest components in shale gas are light alkanes such as ethane and propane. These can be catalytically converted to olefins, which can be further reacted to produce fuels, for example. Olefins from alkanes can be accomplished by dehydrogenation by promoted platinum alloys. This study compares the structure and chemical properties of Pt-Ga alloys on silica (SiO_2) and ceria (CeO_2) supports to determine if the support plays an important role in this chemistry. The catalysts containing different Pt:Ga ratios were synthesized using incipient wetness impregnation. These catalysts were characterized by *in situ* X-ray diffraction (XRD) and X-ray adsorption spectroscopy (XAS) to determine if an alloy was formed, and if so, the structure of that alloy. Finally, the catalysts were tested in a fixed bed reactor, where it was found that the silica-supported Pt-Ga alloy has a selectivity of >90% towards propylene. Understanding catalyst design can lead to higher catalytic conversion of substances and potentially an improved selectivity for the formation of preferred products. Pt-Ga on ceria is tested for comparison and there appears to behave differently from that on silica demonstrating the importance of the role of the support on these catalysts.

KEYWORDS

Heterogeneous catalysis, geometric structure, shale gas, propane dehydrogenation