Methane Pyrolysis for CO_2-free Production of Hydrogen in Molten Manganese-Potassium Chloride Mixtures

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The most economic process for producing hydrogen from methane is a steam reforming, which generates about 300 million tons CO_2 per year as an unwanted co-product. One possible alternative to produce hydrogen from methane without CO_2 emission is methane pyrolysis. The solid carbon produced from methane pyrolysis can be easily separated and stored. However, a commercial solid carbon catalyst is deactivated by carbon coking. In the present work, the co-production of molecular hydrogen and separable carbon from methane is achieved in a bubble column filled with a molten catalyst. Methane is decomposed by contact with a catalytic melt mixture. The solid carbon co-product is separated and collected on the top of melt. Manganese-potassium chloride mixtures show the highest catalytic activity for methane pyrolysis discovered so far. The manganese-potassium chloride complex is considered as a possible active species for methane pyrolysis in the melt. Fundamentals of C-H bond activation and reaction pathway for methane pyrolysis will be discussed.