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Synthesis and characterization of microporous and mesoporous catalysts for shale gas upgrading

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ABSTRACT

The petroleum industry is gradually shifting from using naphtha to ethane as its feedstock and new ethane steam crackers are being built. Using ethane as a feedstock produces more ethene and less co-products such as propene, aromatics and C4 alkenes. Thus, the shift in feedstock will reduce the availability of these co-products. Developing methods for the interconversion of alkenes, and specifically using ethene as a reactant, can solve this problem.

This project focuses on synthesis and characterization of zeolites with the BEA framework topology, and their nickel exchanged versions as potential ethene dimerization catalysts. In future work, these materials will be used to carry out catalytic studies for ethene dimerization. Nickel exchanges were carried out using nickel nitrate $Ni(NO_3)_2$ solution on commercial aluminosilicate samples from Clariant (HCZB-25 Si/Al=12.5) and Zeolyst (CBV Si/Al=12.5) and an in-house synthesized aluminosilicate (Si/Al=13). Nickel exchange was determined to reach equilibrium by 16 hours at 75^{o}C. Nickel exchanges were performed at this equilibration time with varying nickel nitrate molarities (0.005-0.1M), but keeping all other factors constant (temperature at 75^{o}C, stirring at 300 R.P.M), to obtain ion-exchange isotherms that can be used to estimate the fraction of framework metal exchange sites. Zincosilicate molecular sieve CIT-6 samples were also synthesized with different Si/Zn molar ratios (20, 33, 40, 70, 100), in which changes in the Si/Zn ratio in the reactant gel led to changes in the time for crystallization.

KEYWORDS

Zeolites, catalysts, aluminosilicates, zincosilicates

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