Anastasia Kuvayskaya et al., Int J Chem Res. 2020
DOI: dx.doi.org/10.18689/2642-1615.a3.004

Low-waste Synthesis of Long-chain Alkylbenzenes on Superacidic Mesoporous Catalysts Containing Immobilized Phosphotungstic Acid

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To present day, commercial production of long-chain alkylbenzenes is accomplished with aid of liquid Lewis acids ($AlCl_3$ and HF). However, such industrial processing poses a serious threat to the environment due to production of a large volume of toxic waste. The main goal of this work was to synthesize a catalyst allowing low-waste synthesis of long-chain alkylbenzenes. One of the well-studied solid superacids with Keggin structure phosphotungstic acid (PTA) with pKa-13 was chosen for its superior catalytical performance in homogeneous phase. However, low surface area and solubility in polar solvents associated with PTA's activity limited its use in heterogeneous catalysis. PTA was immobilized into mesoporous silica matrix to improve its catalytic performance. Super acidic mesoporous materials containing covalently embedded PTA were synthesized by sol-gel method. Tetraethyl orthosilicate (TEOS) and PTA were used as precursors in the synthesis, ionic and nonionic surfactants were used as pore-forming agents, reaction proceeded in acidic media. TEM images revealed mesoporous structure with embedded PTA clusters. FT-IR spectra of obtained materials contained characteristic bands of PTA at 957 $cm^{-1.}$ Synthesized catalysts had high BET surface area and high concentration of acidic sites. Alkylation of 1,3,5-trimethylbenzene by dec-1-ene demonstrated high catalytic activity. The catalyst obtained with Pluronic P123 as a template was the most effective and resulted in highest conversion of dec-1-ene into alkylated products. Covalent embedding of PTA clusters in addition to thermal and chemical stability of synthesized catalysts enabled their recyclability. Catalysts remained active during subsequent cycles of alkylation.

Biography:

Anastasia Kuvayskaya has completed her BS from East Tennessee State University and presently enrolled in MS program at ETSU. She has been accepted in PhD program at Colorado School of Mines. Anastasia will be joining School of Mines Chemistry department in Fall 2020. She has published 2 papers and attended multiple regional and international conferences.