Synthesis and characterization of high vanadium substituted three-dimensional SBA-16 and its application in the oxidation of styrene

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A systematic study was carried out to examine the direct incorporation of a high level of vanadium into the 3D cubic arrangement of mesopores in SBA-16 molecular sieves. The extent of mesopore structural ordering was determined by X-ray diffraction, N_2 physisorption, SEM and TEM analysis. The coordination and nature of the V sites in SBA-16 were characterized by electron spin resonance, Fourier transform Raman, UV-visible diffuse reflectance and ^{29}Si nuclear magnetic resonance spectroscopy. The formation of polycrystalline was detected at 7.6 wt.% vanadium incorporation into the 3D structure. The surface area was approximately ~1000 m^2/g, while the mesopore volume of the SBA-16 cage ranged from 0.3 to 0.6 cm^3g^{-1}. The pore size distribution was approximately ~3.0 nm with a wall thickness of approximately 10 nm at the maximum. The calcined samples contained both Bronsted and Lewis acid sites with weak acidity. When tested for the oxidation of styrene, the catalytic activity of V-SBA-16 with high Si/V ratio 230 shows high activity compared to other Si/V ratios.