

Optimization of the synthesis of SBA-3 mesoporous materials by experimental design

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SBA-3 mesoporous materials are characterized by hexagonal regular arrangements of channels with diameters >2 nm, high specific surface areas and high specific pore volumes. In the work reported herein, experimental design-response surface methodology (RSM) is used to model and optimize the synthesis conditions for SBA-3 mesoporous materials. In this study, we evaluate the influences of surfactant/silica source molar ratios, aging times, temperature and pH on the synthesis of SBA-3 mesoporous materials by analyzing the XRD intensities pertaining to the [100] signal. Response surfaces were obtained using the BoxBehnken design, and the combination of reaction parameters was optimized. By applying statistical methodology, higher levels of the objective function (XRD intensities pertaining to the [100] signal) were obtained using cetyltrimethylammonium bromide (CTAB)/tetraethyl orthosilicate (TEOS) molar ratios of 0.07 and 0.16, HCl/TEOS molar ratios of 8 and 11, reaction temperatures of 35 and 45 °C and aging times of 12e24 h. The mesoporous SBA-3 samples obtained were characterized using small-angle X-ray powder diffraction (XRD), BET, FTIR and ²⁹Si NMR-MAS, scanning electron microscopy (SEM) and transmission electron microscopy (TEM).