605e Synthesis and Characterization of Organic-Functionalized Pure-Silica-Zeolite

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As the feature size of next-generation microprocessors decreases, the need for low-dielectric constant (low-k) materials with high mechanical strength is an increasing concern. Many potential porous materials take advantage of the low k value of air, which is about 1, but they are often amorphous in nature and thus lack mechanical strength. Porous zeolites, however, are highly crystalline and have a high elastic modulus while retaining the low k values of amorphous porous silica materials.[1] Since water has a high k value, moisture adsorption is a serious concern for all porous low-k materials. Consequently, along with low k and high elastic modulus values, hydrophobicity is becoming an increasingly important parameter.[2],[3] To combat this problem, post-spin-on silylation treatments with chlorotrimethylsilane and hexamethyldisilazane have been performed, and pure-silica zeolite (PSZ) MFI has been functionalized with methyltrimethoxysilane.[4] Here, we report an organic functionalized pure-silica zeolite with an MFI-type structure prepared through a direct-synthesis method by adding a fluorinated silane to the synthesis solution, and the added fluorine functionality increased the hydrophobicity of the zeolite. The zeolite was characterized by x-ray diffraction, ^{29}Si solid-state nuclear magnetic resonance spectroscopy, nitrogen adsorption, FT infrared spectroscopy, and thermogravimetric analysis. Spin-on films from the nanoparticle suspension exhibited higher water contact angles than pure-silica zeolite MFI films, and the zeolite powders had low water content.

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