476c Microstructure Engineering of Mesoporous Silica Films

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It is of great interest to use self-assembled mesoporous silica films to fabricate multiscale and multifunctional structures for energy-/bio-MEMS devices, including micro fuel cells, bio-sensors/-separators, and bio-photonics. One of the key components of such MEMS devices is functional porous film structure with feature sizes on the order of a nanometer. Despite recent development in MEMS technology, it is still a significant challenge to create such porous nanostructure on multiple length scales in cost-effective ways mainly owing to the limitation of conventional top-down photolithography approach. Self-assembled mesoporous silica films can be an alternative to creating such nanostructure in facile manners since they can be easily coated using conventional coating techniques (spin-coating and dip-coating), readily functionalized with functional organic groups, and are compatible with current silicon microfabrication technology.1 To harvest the full promise of the self-assembled silica nanostructure in MEMS application, it is desirable to have the ability to control nanoporous structures such as pore dimension and direction. While the pore size can be controlled in situ by using surfactants of different size, this method has limitation since certain pore structures can only be synthesized using certain surfactants (for instance, CTAB for 3D hexagonal phase) 2. Therefore, it is desirable to be able to control pore sizes using ex situ methods while maintaining overall crystal phases of the mesoporous films3. Besides the ex situ pore size control, the control of the pore direction over large length scale (for instance, in the scale of the size of wafers) is vital for MEMS applications. Many researches have been devoted to control pore directions by various methods4-6. Most of the methods are not compatible to the conventional microfabrication technology due to the long synthesis time, the poor order of the pores, and the complicated processes. In this talk, we will show that the pore size of the mesoporous silica film can be systematically controlled by incorporating dimethylalkylamine into the pores of the silica films. We will also talk about ordering the pore structures of the mesoporous silica films over entire 2 inch silicon wafers. This is achieved by first creating periodic surface pattern (hydrophilic and hydrophobic) on the wafer and subsequently coating the surface with the silica sol using dip-coating.

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