The Porous Properties of Mesoporous Silica Thin Films Characterized by X-ray Reflectivity

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Mesoporous silica films of thickness 0.1–0.2 μm supported on silica wafer substrates were fabricated by sol-gel coating method through nonionic block copolymers P123 of surfactant templating synthesis. For preparing as-synthesized P123 films, the silica sol was made by the molar ratio of 1 TEOS: 0.003-0.08 P123: 5.5-7.5 H_2O: 0.001-0.045 HCl: 10-60 EtOH. The precursor solution was then aged at rt. for 7 days, and dip-coated on Si-wafer at constant dip rate of 18 cm/min.

Mechanical strength and stability of mesoporous silica films are important prerequisites for their optical and electronic applications, and good mechanical properties can, in turn, be achieved through well-organized film texture. Furthermore, the scope of applications of mesoporous films is closely associated with their pore properties such as pore size, porosity and pore structure. The organic template removal methodology has a dramatic influence on the porous structure and properties of mesoporous silica films. Therefore, there are two organic template removal methods that included calcinations and solvent extraction. X-ray reflectivity technique was used to investigate the film thickness, density and surface roughness. The 2D GIXRD was employed for check the mesostructures of mesoporous silica thin film. From the results of XRR, the critical angle of total reflection indicate that the densities of silica films treatment with solvent extraction calcination are higher than treatment with calcination. In addition, the d-spacing and thickness of the film extracted with solvent are larger than treatment with calcinations (Fig.1 & Fig.2)

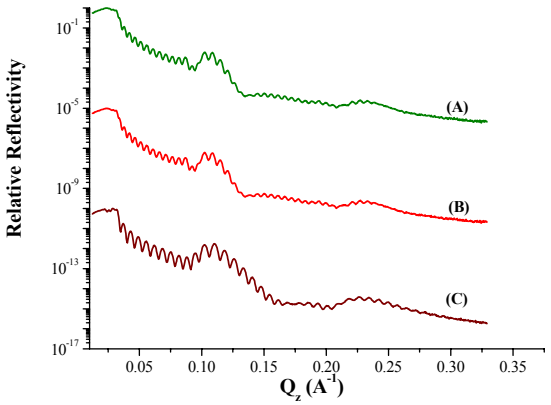

Figure 1. X-ray reflectivity profiles of (A) as, (B) solvent extraction, and (C) calcined P123 films.

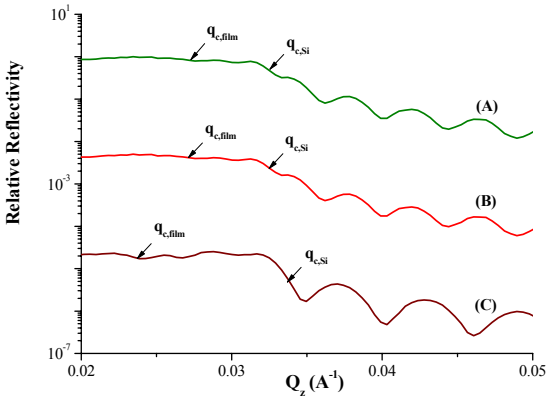

Figure 2. The critical angle of mesoporous silica thin films
(A) as, (B) solvent extraction, and (C) calcined.