

## Uniaxial Self-assembled Mesoporous Silica Films

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**Abstract** – Mesoporous materials synthesized through self-assembling of surfactants are of special interest as host materials because of their highly ordered porous structures and controllability of morphologies. The synthesis of ordered mesoporous silica are by self-assembly of Pluronic 123 and SBA-15. It is possible to obtain pore sizes around 5 nm. The polyimide was prepared by spin-coating from a poly(amic acid) followed by thermal imidization and further underwent rubbing treatment. The mesostructured silica film was performed from dip-coating using as substrate the film with a rubbing-treated. Determination of pore sizes and order range is presently in process, with regard to uniaxial mesostructure in the film plane, induced by the rubby-treated polyimide.

Mesoporous materials synthesized through self-assembling of surfactants are of special interest as host materials because of their highly ordered porous structures and controllability of morphologies [1-3]. Ordered mesoporous silica materials are synthesized by self-assembly of surfactant and silica species.

In this work, synthesis is achieved by using SBA-15 and Pluronic 123 (P123) was used as surfactant. For this case, it is possible to obtain pore sizes around 5 nm [4]. The method to obtain alignment control of the mesochannels consisted of rubbing-treated polyimide coatings on silicon substrate [4-5].

The polyimide was prepared by spin-coating from a poly(amic acid) (PAA), prepared as usual, by reacting equimolar quantities of pyromellitic dianhydride and hexamethylenediamine in dimethylacetamide (DMAc). The solution of PAA was spin-coated on silicon and the film was obtained by heat treatment at 80°C for 1h and further heating at 250°C for 2h in open atmosphere [6]. The result film on silicon underwent rubbing treatment by use of a nylon-covered cylindrical roller.

The mesostructured silica film was obtained through hydrolysis of silicon alkoxide in the presence of P123 under acidic conditions. Film formation was achieved by dip-coating on the rubbing-treated polyimide film. The thickness of the film was determined by profilometry (Model XP-2 of Ambios Technology), and thicknesses in the range of 0,1µm – 1,33µm were obtained, depending of DMAc concentration and spin speed, as shown at table 1. Determination of pore sizes and order range is presently in process, with regard to uniaxial mesostructure in the film plane, induced by the rubby-treated polyimide sublayer.

**Table 1:** PAA solution concentration in DMAc solvent and spin speeds used to fabricate polyimide films and their thickness measured by Profilometry.

Concentration	Spin speed (rpm)	Thickness (µm)
10%wt	3500	1.36
10%wt	4500	1.08
10%wt	5000	0.12

### References

- [1] Lu, Y.; Ganguli, R.; Drewien, C. A.; Anderson, M. T.; Brinker, C. J.; Gong, W.; Guo, Y.; Soyey, H.; Dunn, B.; Huang, M. H.; Zink, J. I. *Nature* 1997, **389**, 364.
- [2] Hayward, R. C.; Alberius, P. C. A.; Kramer, E. J.; Chmelka, B. F. *Langmuir*, 2004, **20**, 5998.
- [3] Miyata, H.; Suzuki, T.; Fukuoka, A.; Sawada, T.; Watanabe, M.; Noma, T.; Takada, K.; Mukaide, T.; Kuroda, K. *Nat. Mater.* 2004, **3**, 651.
- [4] Su, B.; Lu, X.; Lu, Q.; *Langmuir*, 2008, **24**, 9695-9699.
- [5] Miyata, H.; Noma, T.; Watanabe, M.; Kuroda, K. *Chem. Mater.*, 2002, **14**, 766-772.
- [6] Mittal, K. L. *Polyimides*; Plenum Press: New York, 1984.