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Fabrication of submicrometric patterns from self-organized structures of block copolymers and transcription on solid surfaces

(1) Instituto de Física de São R. H. Longaresi[(1)], A. J. F. Carvalho[(2)], M.A. Pereira-da-Silva[(1),(3)], and R.M. Faria[(1)]

Carlos - USP, São Carlos 13560-970, SP, Brazil
(2) Universidade Federal de São Carlos, Campus Sorocaba, 18043-970,Sorocaba, SP, Brazil
(3) Centro Universitário Central Paulista, UNICEP, 13563-470, São Carlos, SP, Brazil
faria@ifsc.usp.br

Abstract – Microphase separation of molecular components of block copolymers leads to the formation of different well-arranged structures, and when thin films are formed, to self-organized submicrometric patterns. In this work we used some of these organized structures to fabricate template and replicas that can be for applications in soft lithography and in other technological branches (medicine and pharmacology, lubrication technology, microelectronics, etc.).

A current and relevant topic in nanoscience and nanotechnology is the production of organized structures that can be used as functional nano/micropatterns for electronics, microfluidic devices, or drug delivery systems[1,2]. Self-organization of soft materials in submicrometric scale combined with replica molding technique has shown a quick progress towards the fabrication of different nanostructures and soft imprinting lithography[3,4]. Recently, highly ordered mesoscopic patterns of submicrometric structures were obtained onto mica substrates from dewetting of poly(styrene)-b-poly(ethene-co-butene-1)-b-poly(styrene) copolymer dissolved in toluene[5], showing potential applications in submicrometric electronic arrangements. In this work we discuss the dynamics of the formation of self-organized structures and we present a progress towards the fabrication of self-organized SEBS structures and in its replication making use of easy, fast and inexpensive techniques. Quantitative computational analyses applied to AFM images of the original self-organized structure, as well as, those of the derivative template and the final replica, were used as fundamental tools to check the success of each stage of the process. In addition, these analyses provided comparison of geometric regularities of the three structures: original self-organized copolymer structure, the mold template, and its replica. In order to evaluate the droplet pattern formation, three different measurements were employed. First, we examined carefully the defects observed in the obtained hexagonal structures. Then, the hexagonality index was used to quantify the local organization of the droplets, measuring how close its spatial distribution is to a perfect hexagonal lattice. Finally, in the third analysis, the radial distribution function was used to evaluate larger scale spatial regularity of the droplets distribution. This function describes the spherically averaged organization around any given droplet.

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