SURFACE NANOPATTERNING OF HARD AND SOFT THIN FILMS BY A REPLICA-MOLDING APPROACH

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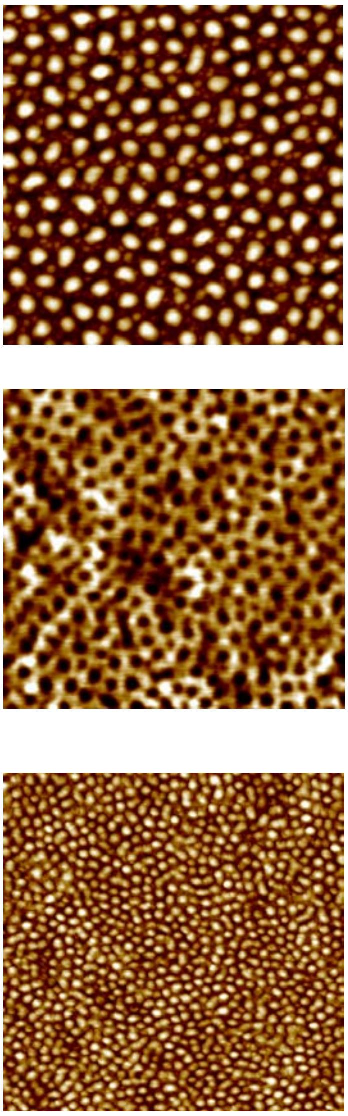
One key topic in nanoscience and nanotechnology is the development of new strategies for nanostructuring material surfaces since the surface topography may substantially affect the properties of the material [1]. Thus, in the last years different techniques have been developed for nanostructuring in an accurate manner metal, semiconductor and polymer surfaces. Unfortunately, many of these techniques are not suitable for serial fabrication of nanostructured surfaces due to their high cost, low resolution or limited scale range.

In this work, we report on our recent results obtained by a replica-molding approach for large-scale surface nanopatterning. Two materials with quite different mechanical properties have been naopatterned, namely: titanium nitride (TiN) films deposited by reactive sputtering and polystyrene films deposited by the casting procedure. In order to explore the capabilities of this strategy we have used in both cases as master surfaces to be replicated silicon surfaces previously nanostructured by low-energy ion-beam sputtering [2]. The original template pattern was formed by an array of silicon lenticular nanodots, 6 nm of average height and 40-50 nm of lateral size, displaying short-range hexagonal order (Figure 1, top).

By this replica-molding approach both, a mold or a replica of the original nanodot array can be achieved on both materials (Figure 1, middle and bottom). Thus, the resulting ceramic and polymeric surfaces showed a nanopatterned surface on which either the original nanodot pattern (i.e. replica) or the molded nanohole pattern (i.e. molding) was transferred with high resolution [3].

These results show that the proposed surface nanostructuring route is suitable for large-scale and accurate patterning of features on hard material surfaces. The goal of our approach is to extend the advantages of molding techniques (low-cost, large-scale, high-resolution, low time-consuming) to hard ceramic materials that are commonly very difficult to micromachine and metal films [4].

Figure 1: Top: 500 x 500 nm^2 AFM image of the original nanostructured template. Middle: 500 x 500 nm^2 AFM image of the TiN nano-molded film. Bottom: 1.2 x 1.2 μm^2 AFM image of the nano-replicated TiN film.



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