Poster

ORDERED ARRAYS OF POLYMER MICROFIBERS OBTAINED USING MACROPOROUS SILICON AS TEMPLATE

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In recent years, the fabrication of nanostructures and microstructures based on porous templates has caused much interest [1,2]. The deposition of specific materials into porous templates allows tailoring structures as inverse replicas of the porous. The use of ordered porous arranged in a regular lattice allows fabrication of ordered fiber arrays.

In this context, we have used a simple technique for the fabrication of polymer microfibers with a monodispersive size distribution and uniform orientation using ordered macroporous silicon templates.

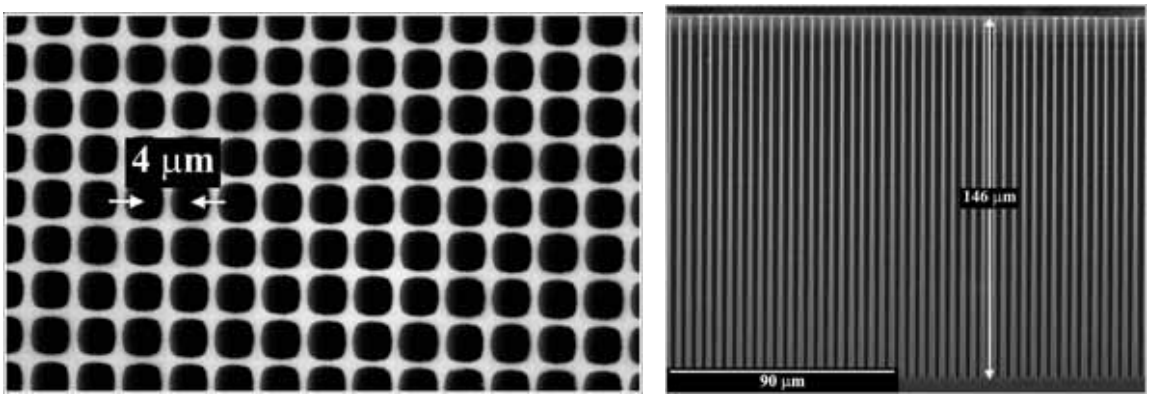
We prepared the ordered porous silicon membranes by light-assisted electrochemical etching [3]. The starting material was n-type silicon with a resistivity of 2–6 Ωcm. The front side of the wafers was patterned with inverted pyramid shaped pits by oxidation, photolithography, and subsequent tetramethyl ammonium hydroxide (TMAH) etching. These inverted pyramids act as nucleation sites for the ordered pore growth. The wafers were incorporated in an electrochemical etching cell containing a 2.5 wt% aqueous solution of HF acid. The quality and size of the pores was controlled by a computerized feedback mechanism to maintain a constant current. After pore growth, the back side of the wafer was etched until the holes opened. As shown in Figure 1, the pores of the silicon templates were very uniform in size and depth (~146 μm)

Ordered polymer microfibers were prepared immersing the template in a precursor solution, PMMA/Toluene to obtain rigid polymer or in silicone elastomer (PDMS) mixed with curing agent (10:1) to obtain elastic polymer, and then cured at 110°C for 3h. To removed the template, it was immersed into 40 wt% KOH(aq) at 40°C in the case of PMMA or it was mechanically peeled off the substrate in the case of the PDMS. Scanning electron microscopy (SEM) confirms that the photonic structure of the porous Si is retained in the polymer casting (Figures 2 and 3).

References:

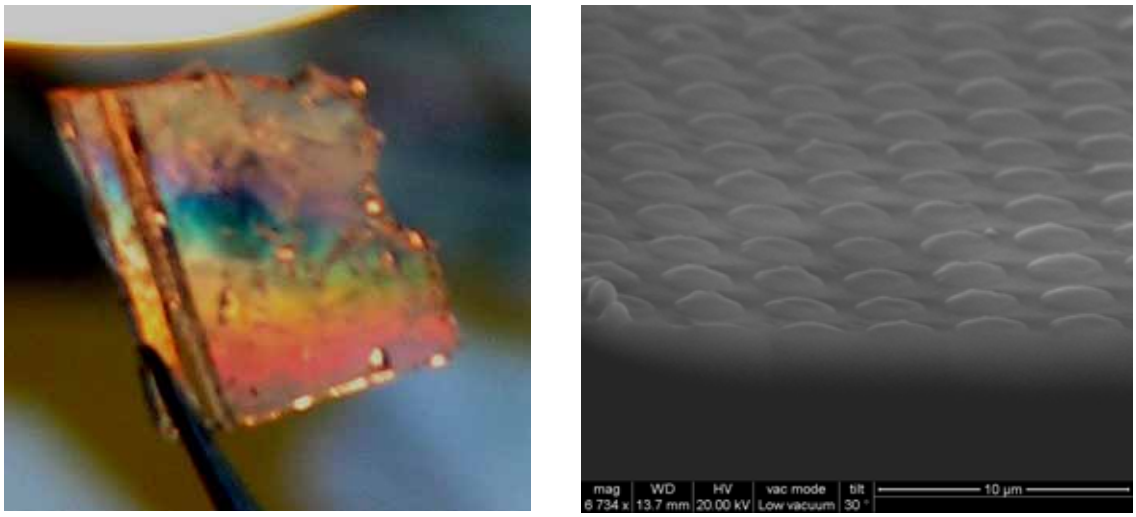
[1] X. Chen, M. Steinhart, C. Hess and U. Gösele, Advanced Materials, **18** (2006) 2153
[2] M. Steinhart, J.H. Wendorff, A. Creiner, R.B. Wehrspohn, K. Nielsch, J. Schilling, J. Choi, U. Gösele, Science, **296** (20032) 1997
[3] T. Trifonov, L. F. Marsal, A. Rodríguez, J. Pallarès, R. Alcubilla, Physica Status Solidi (c), 2 (2005) 3104.

Figures:



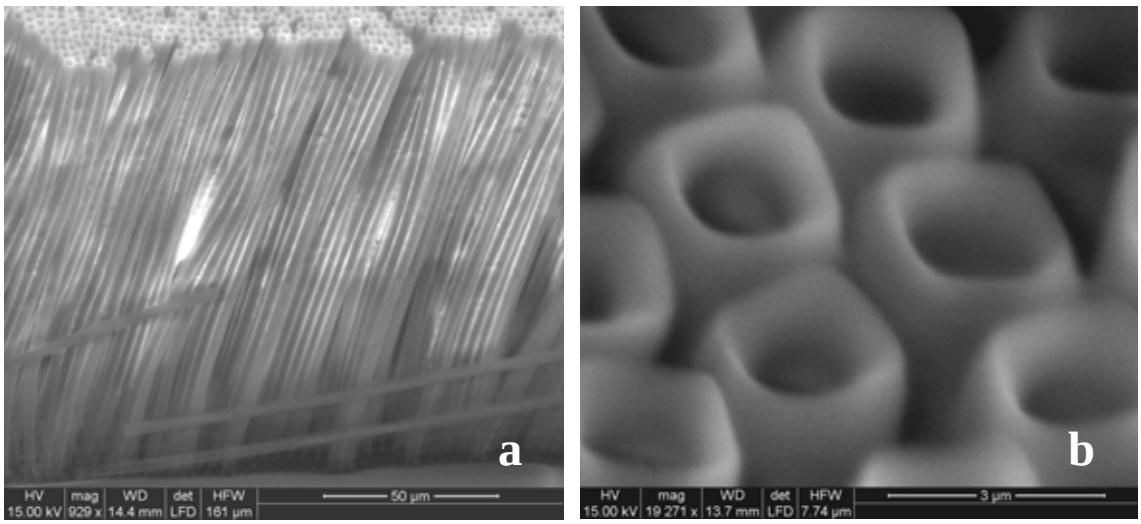
a) b)

Figure 1. Scanning electron microscopy (SEM) images of top surface (a) and cross section (b) of an n-type ordered porous silicon template.



a) b)

Figure 2. a) Iridescent color resulting from the scattering of visible light by the periodic structure of PDMS. b) SEM image of the PDMS surface after pull-off the silicon template.



a) b)

Figure 3. SEM images of PMMA microfibers after removed the silicon template. a) Cross-sectional view of some PMMA microfibers. b) Top view of the PMMA microfibers.