210 UV laser fabrication of nanostructured porous silicon based platforms for biological applications

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Nanostructured porous silicon (nanoPS) can be regarded as a complex network of silicon nanocrystals embedded in a porous matrix. NanoPS is fabricated by the electrochemical etching of silicon wafers in HF-based solutions. When crystalline Si is transformed into nanoPS, its intrinsic properties are altered owing to quantum confinement effects. That makes nanoPS an excellent candidate for the development of several applications in a broad range of fields including optoelectronics, photonics [1], biomedicine [2], etc.

On the other hand, surface micro- and nano-patterning is becoming an important means to enhance the performance of materials. In particular, nanoPS patterns have been proposed for the fabrication of photonic devices, high-sensitivity sensors, etc. Different techniques have been used for fabricating patterns on nanoPS including microstructuring the crystalline silicon substrate before the electrochemical etching process, dry soft lithography, stamp pressing, etc. However, none of these methods has the capability to offer flexibility in the pattern design in a time-efficient process, in large areas, and in a single step process.

The present work reports on the fabrication of 1D and 2D platforms on nanoPS by phase-mask UV laser interference. This method is a single-step and flexible approach to produce a large variety of patterns formed by alternate regions of almost untransformed nanoPS and regions where its surface has melted and transformed in Si nanoparticles.

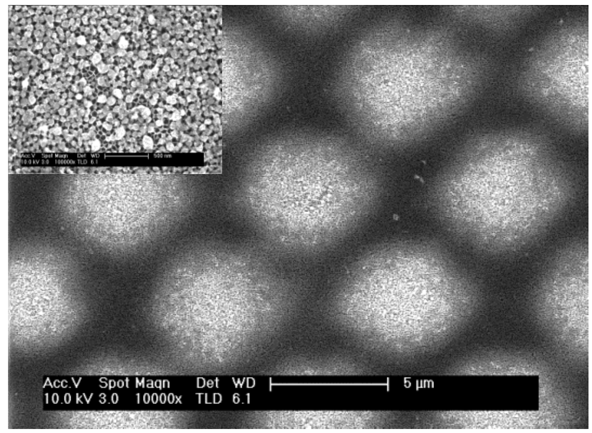

Fig. 1 *Scanning electron microscopy (SEM) image of 2D pattern on nanoPS fabricated by phase-mask UV laser interference. The inset shows a zoom of an irradiated zone.*

Figure 1 shows a typical 2D pattern fabricated by phase-mask laser interference using a single pulse of an UV excimer laser (193 nm, 20 ns). The pattern is formed by unaffected nanoPS regions and irradiated regions where nanoPS has melted and transformed to Si nanocrystals (inset of figure 1). By changing the main experimental parameters such as nanoPS layer porosity, average pore size, laser fluence or pattern period, the properties of the resulting structures can be controlled. These patterns have been proved as good candidates for sensing and for the development of biological platforms [3].

References

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