TECHNOLOGICAL ASPECTS IN FABRICATION OF MICRO- AND NANO-SIZED CARBON-BASED STRUCTURES: NANORODS, PERIODICAL ARRAYS AND SELF-STANDING MEMBRANES

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Abstract

Diamond and carbon thin films due to their variability and superior mechanical, optical, electrical, and biocompatible properties, become widely used over the world in multi-disciplinary fields such as material engineering, optoelectronics, biochemistry, life science or even microbiology (anti-adhesive and antibacterial coatings). However, their intrinsic properties have to be tailored to specific requirements (like surface morphology, electrical conductivity, transparency, etc.).

In this contribution we point out the key technological aspects in fabrication of micro- and nano-sized carbon-based structures. The diamond nanorods were fabricated by employing plasma-assisted thermal annealing of thin metal layers (Au and Ni) followed by reactive ion etching of planar diamond films (the top-down strategy). We found that the diameter of diamond nanorods can be controlled in a broad range from 10 to 200 nm by the masking material and its initial thickness. The self-assembled templates (periodical arrays) of polystyrene (PS) microspheres (500 or 1000 nm in diameter) were fabricated by their spin-coating on silicon and diamond substrates. Except to spin-coating process parameters, the concentration of PS microspheres dispersed in DI/ethanol was a crucial technological parameter to assemble them into monolayer. We will discuss application of PS microspheres in fabrication of periodical diamond arrays. The self-standing diamond membranes were fabricated by selective area deposition employing optical lithography and wet etching (bottom-up strategy). The initial diamond growth from the seeding layer, etching of carbon phases by oxygen containing gas species and parasitical diamond growth were the main competitive processes resulting in successful fabrication of self-standing diamond membranes in mesh- or interdigital-like geometry.

Keywords: Diamond thin films, carbon, nanorods, microsphere lithography, selective area deposition, RIE, SEM

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