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Research outputs:

**Transfer of Direct and Moiré Patterns by Reactive Ion Etching Through Ex Situ Fabricated Nanoporous Polymer Masks**
We present a conceptually simple approach to nanolithographic patterning utilizing ex situ fabricated nanoporous masks from block copolymers. The fabricated block copolymer (BC) masks show predictable morphology based on the correlation between BC composition and bulk properties, independent of substrates' surface properties. The masks are prepared by microtoming of prealigned copolymer monoliths of hexagonal morphology at controlled angles; they appear as 30-60 nm thick films of typical dimensions 100 mu m x 200 mu m. Masks cut perpendicular to the cylindrical axis show monocrystalline hexagonal packing of 10 nm pores with a principal period of 20 nm. We demonstrate the transfer of the hexagonal pattern onto silicon by means of reactive ion etching through the masks. In addition, patterns elliptic and slit-like holes on silicon are obtained by utilizing masks cut at 45 degrees relative to the cylinder axis. Finally, we demonstrate the first transfer of moire patterns from block copolymer masks to substrate. The nanoporous masks prepared ex situ show outstanding long-range order and can be applied directly onto any flat substrate, eliminating the need for topographic and chemical surface modification, which are essential prerequisites for the conventional procedure of block copolymer directed self-assembly. The demonstrated elliptic and moire pattern transfers prove that the proposed ex situ procedure allows us to realize nanolithographic patterns that are difficult to realize by the conventional approach alone.

General information

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Publication information
Automatic identification of single- and/or few-layer thin-film material

One or more digital representations of single- (101) and/or few-layer (102) thin-film material are automatically identified robustly and reliably in a digital image (100), the digital image (100) having a predetermined number of colour components, by - determining (304) a background colour component of the digital image (100) for each colour component, and - determining or estimating (306) a colour component of thin-film material to be identified in the digital image (100) for each colour component by obtaining a pre-determined contrast value (C R; C G; C B) for each colour component and multiplying the respective background colour component with a numerical difference between the pre-determined contrast value (C R; C G; C B) for a given colour component and about 1, - identifying points or parts of the image with all colour components being within a predetermined range of the determined or estimated colour component.

Large-area nanopatterned graphene for ultrasensitive gas sensing

Chemical vapor deposited (CVD) graphene is nanopatterned using a spherical block copolymer etch mask. The use of spherical rather than cylindrical block copolymers allows homogeneous patterning of cm-scale areas without any substrate surface treatment. Raman spectroscopy was used to study the controlled generation of point defects in the graphene lattice with increasing etching time, confirming that along the nanomesh patterning, the nanopatterned CVD graphene presents a high defect density between the mesh holes. The nanopatterned samples showed sensitivities for NO2 of more than one order of magnitude higher than for non-patterned graphene. NO2 concentrations as low as 300 ppt were detected with an ultimate detection limit of tens of ppt. This is the smallest value reported so far for non-UV illuminated graphene chemiresistive NO2 gas sensors. The dramatic improvement in the gas sensitivity is believed to be due to the high adsorption site density, thanks to the combination of edge sites and point defect sites. This work opens the possibility of large area fabrication of nanopatterned graphene with extremely high densities of adsorption sites for sensing applications.