

Focused ion beam induced synthesis of free-standing graphite nanosheets

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In recent years, carbon nanostructures have attracted great attention as building blocks in nanotechnology. To further comprehend processes in nanoscale regime we intensively investigated graphite under various conditions.

Highly ordered pyrolytic graphite (HOPG) was irradiated with focused ion beam (FIB) with a kinetic energy of 30 keV. The surface modifications as a function of angle of ion beam incidence ($\theta=0^\circ$ - 55°), fluence ($\Phi= 1,2 \cdot 10^{15}$ - $2,9 \cdot 10^{17}$ ions/cm²) and surface temperature ($T= RT$ - 600°C) was investigated by scanning electron microscopy and AFM imaging.

At room temperature physical sputtering was observed leading to flat bottomed boxes independent of the ion fluencies. For a substrate temperature of 300°C ripples were observed on the HOPG surface. Pretreatment with small ion fluence allows us to modify the wavelike character of these ripples. At a substrate temperature of 600°C the HOPG surface transforms to cellular like structures. Fig. 1 shows exemplarily the influence of the surface temperature for FIB sputtering of HOPG.

Furthermore we present an approach for focused ion beam induced synthesis of free-standing graphite nanosheets with a thickness below 80 nm oriented parallel to the FIB (see Fig 2). At a substrate temperature of 600°C a self assembled free standing carbon nanosheet was formed. An SEM video has been made which shows the assembling of this carbon nanosheet in situ and in real-time. Such carbon nanosheets appears to be crystalline and shows effective photoluminescence at telecommunication wavelength (see Figure 3)

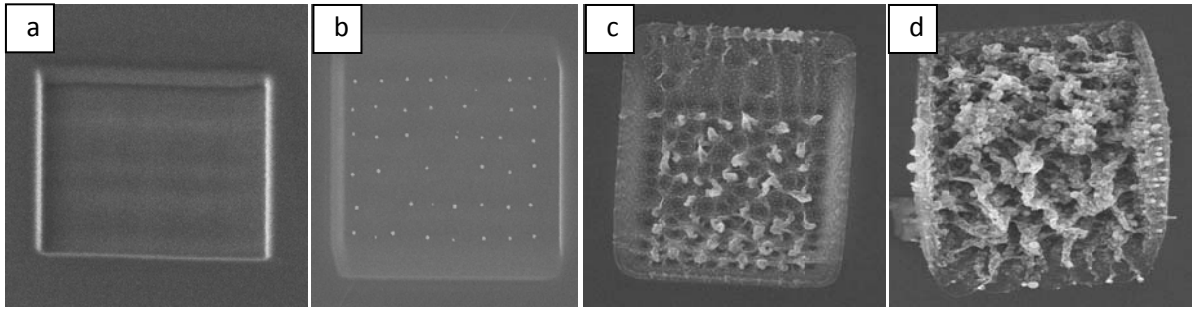


Fig. 1: SEM images of the surface after FIB sputtering of carbon (highly ordered pyrolytic graphite) at substrate temperatures of (a) 25°C, (b) 100°C, (c) 300°C and (d) 600°C.

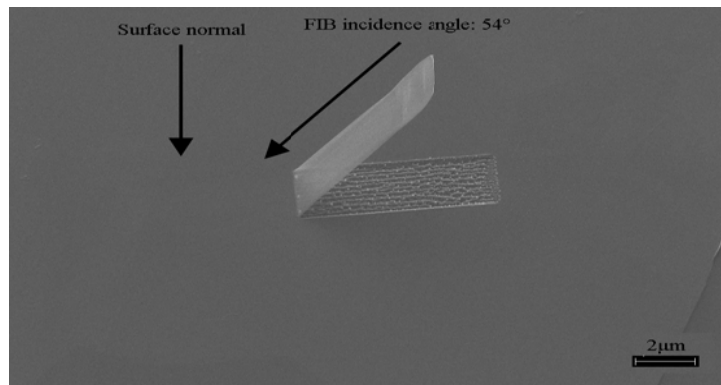


Fig. 2: SEM image of the free-standing carbon nanosheet achieved by FIB sputtering of HOPG at 600°C.

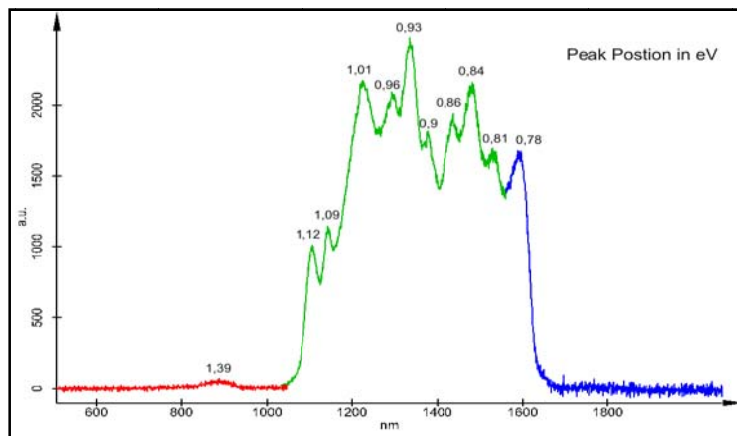


Fig. 3: PL spectrum of the free-standing carbon nanosheet.

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