STRUCTURED HOPG SURFACES AS A SOURCE OF TAILORED NANOGRAPHENE SHEETS

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The motivation for this work results from recent progress in the construction of carbon-based transistors which are of great relevance for the modern electronics [1]. The new key element in such devices is the so called nanographene flake, nG, representing a system comprising of nearly free electrons confined in 2D-solid [2]. Our main purpose was to routinely create graphene-based nm-sized structures and characterize them through AFM and SEM techniques. The focused ion beam technique, Ga^+-FIB, followed by high-temperature oxidation has been applied to fabricate arrays of well defined periodic structures on HOPG surfaces [3]. The reactive structuring method exploits the high probability of amorphous carbon to be gasified in the oxidation reaction. Large surface areas (5 x 5 mm) covered by periodically arranged nanocavities, gratings and arrays of nm-sized cube-like blocks have been fabricated routinely.

The latter represent stacks of square-shaped nG sheets in quantities of up to 10^{12} cm^{-2} and can be created with mean fabrication rates of $\sim 10^6$ nG/cm^2s. Under optimal patterning conditions, the rectangular blocks of stacked nG sheets can be routinely fabricated with a mean efficiency of $\sim 10^{-10}$ C/O_2.

SEM images of the large patterned areas evidence considerable amounts of nG sheets decoupled from the substrate. We tentatively assigned this effect to electric charging induced by exposing the surface to the electron beam. This exfoliation procedure appears more efficient when increasing the nG-nG spacing in the blocks by intercalated C_{60} molecules. In both cases we observed a spontaneous bunching of the exfoliated sheets.

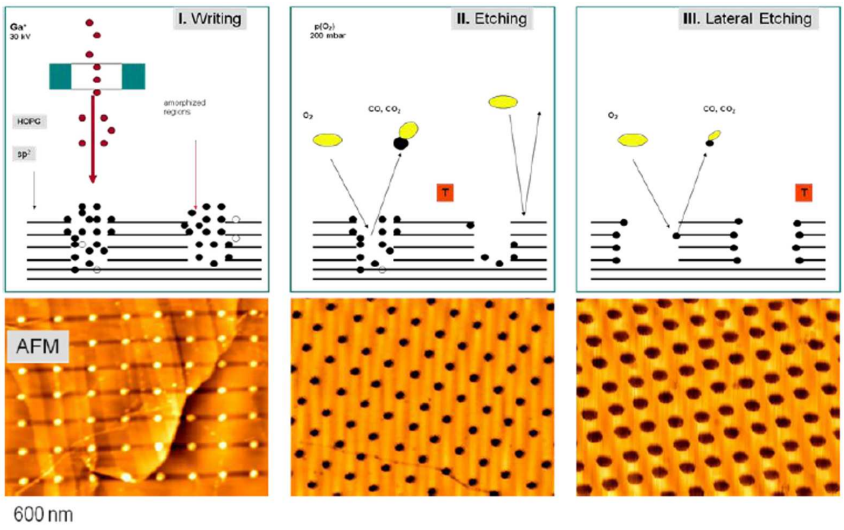

Figure 1: Etch mechanism.

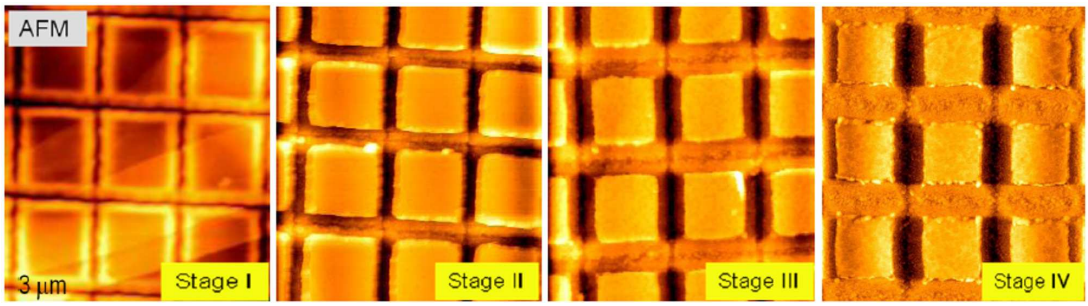

Figure 2: Etch kinetics.

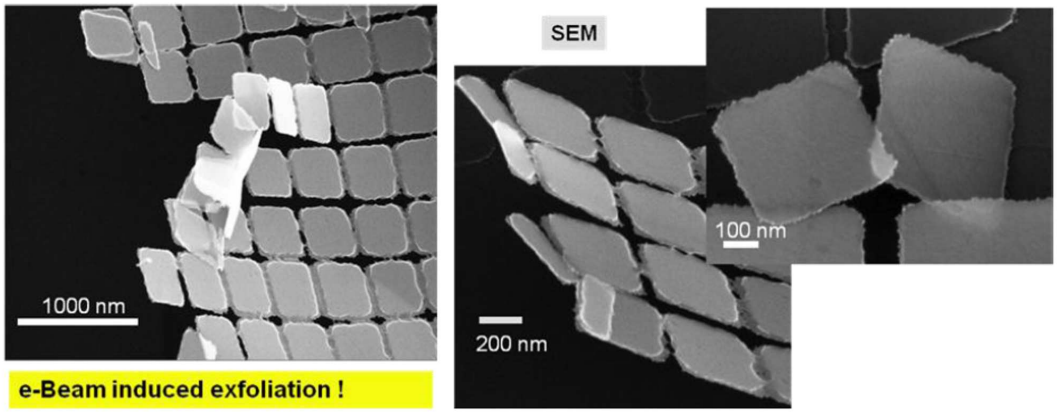

Figure 3: Multilayered nG sheets decoupled from the substrate

References

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[2] K.S. Novoselov, A.K. Geim, S.V. Morozov, D. Jiang, M.I. Katsnelson, I.V. Grigorieva, S.V. Dubonos, and A.A. Firsov, Nature Letters 438 (2005) 197.
[3] A. Böttcher *et al.*, Nanotechnology 17 (2006) 5889.
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