Large anisotropic single crystal epitaxial graphene flakes isolated from SiC wafers

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Beyond fundamental studies on mechanically exfoliated HOPG, best electronic devices are based on high quality graphene obtained either by CVD on Cu foils or epitaxial graphene (EG) on SiC [1]. In this work, we report some preliminary results on the development of electrical devices based on large anisotropic single crystal EG flakes obtained on the C-face of SiC by high temperature sublimation [2]. The as-grown isolated EG flakes can be detached and transferred to e.g. SiO_2 substrate by PMMA-assisted electrochemical delamination technique, which is a non-destructive, reproducible and low-cost exfoliation method that has been adapted to EG on SiC [3]. For the fabrication of graphene electrical contacts simple alignment and patterning by e-beam lithography, thin film evaporation and resist lift off process was employed. As-deposited EG materials consist in hundreds-µm-long, tens-of-µm-wide SLG to FLG EG islands, covering typical regularly step-bunched SiC (Fig. 1 (a, b)). The transferred materials on SiO_2 somehow reproduce that SiC substrate terrace topography (Fig. 1(c)). Examples of Raman spectra of transferred EG are shown in (Fig. 1 (d). The electrical characteristics have been tested via 4-probe method on three different devices. The linear I-V relationship reveals the presence of ohmic contacts displaying resistances ranging from 1.2kΩ to 2.3kΩ (Fig. 1 (f). Yet, these values could be easily improved by applying dedicated treatments prior e.g. to metal deposition, such as plasma treatments [4] of the contact areas or post deposition treatments such as rapid thermal annealing [5]. Both structural and electronic characterization indicate that high crystalline quality of EG is basically preserved upon electrochemical transfer as well as device fabrication.

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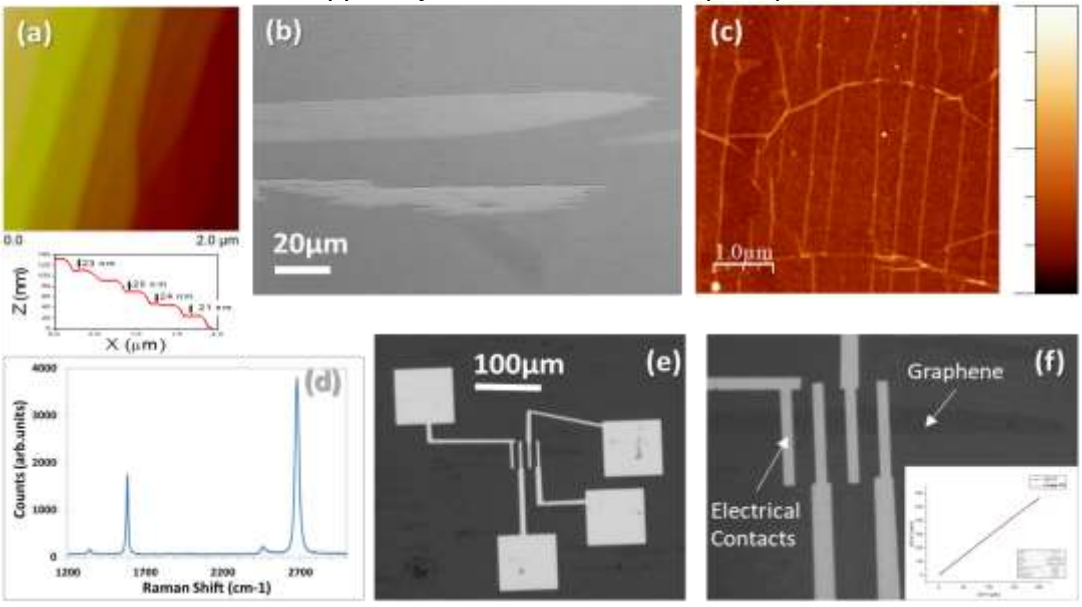

Figures 1: (a) AFM image of as-grown EG on SiC; (b) optical image of as-grown EG on SiC; (c) AFM image of transferred EG on SiO_2 (Z scale=20nm); (d) exemplary Raman spectra after transfer; (e) optical image of a large anisotropic EG flake interfaced by 4 probes electrical device; (f) optical image and electrical characteristics a SLG/BLG electronic device.