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ID-10-P-3266 Dry-cleaning of graphene

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Graphene is thought to be the ultimate support for TEM studies with its outstanding physical and chemical properties, one-atom thickness and low background signal contribution. But contamination introduced during fabrication and transfer as well as the airborne contaminants adsorbed on graphene hinder the potential of graphene as support for the studies of inorganic, organic and biological nano-objects. Here, we present a simple and efficient table-top method for cleaning graphene using activated carbon, dry-cleaning. The dry-cleaned graphene samples were characterised by aberration-corrected high-resolution transmission electron microscopy (AC-HRTEM) using an imaging-side aberration corrector FEI TITAN 80-300 operated at 80 kV . The cleanness of graphene improved from 6% for a non-cleaned graphene to 95% for dry-cleaned graphene with activated carbon (Figrue 1 A and B) with clean areas in the micrometer range. Cleanness is defined as the ratio of the contamination-free area to total sample area. The efficient removal of carbonaceous contamiantion was confirmed by Auger Electron spectroscopy, AES (Figure 1 C). The residual contamination after dry-cleaning was observed to contain Si, as seen by the electron energy loss (EEL) spectrum in Figure 1 (D). Interestingly, bilayer and triple-layer graphene does not get clean by our dry-cleaning method nor by other cleaning methods, e.g. UHV annealing. As dry-cleaning with activated carbon was only performed in graphene, we can speculate that dry-cleaning with activated carbon can be used to clean surfaces of other TEM samples.

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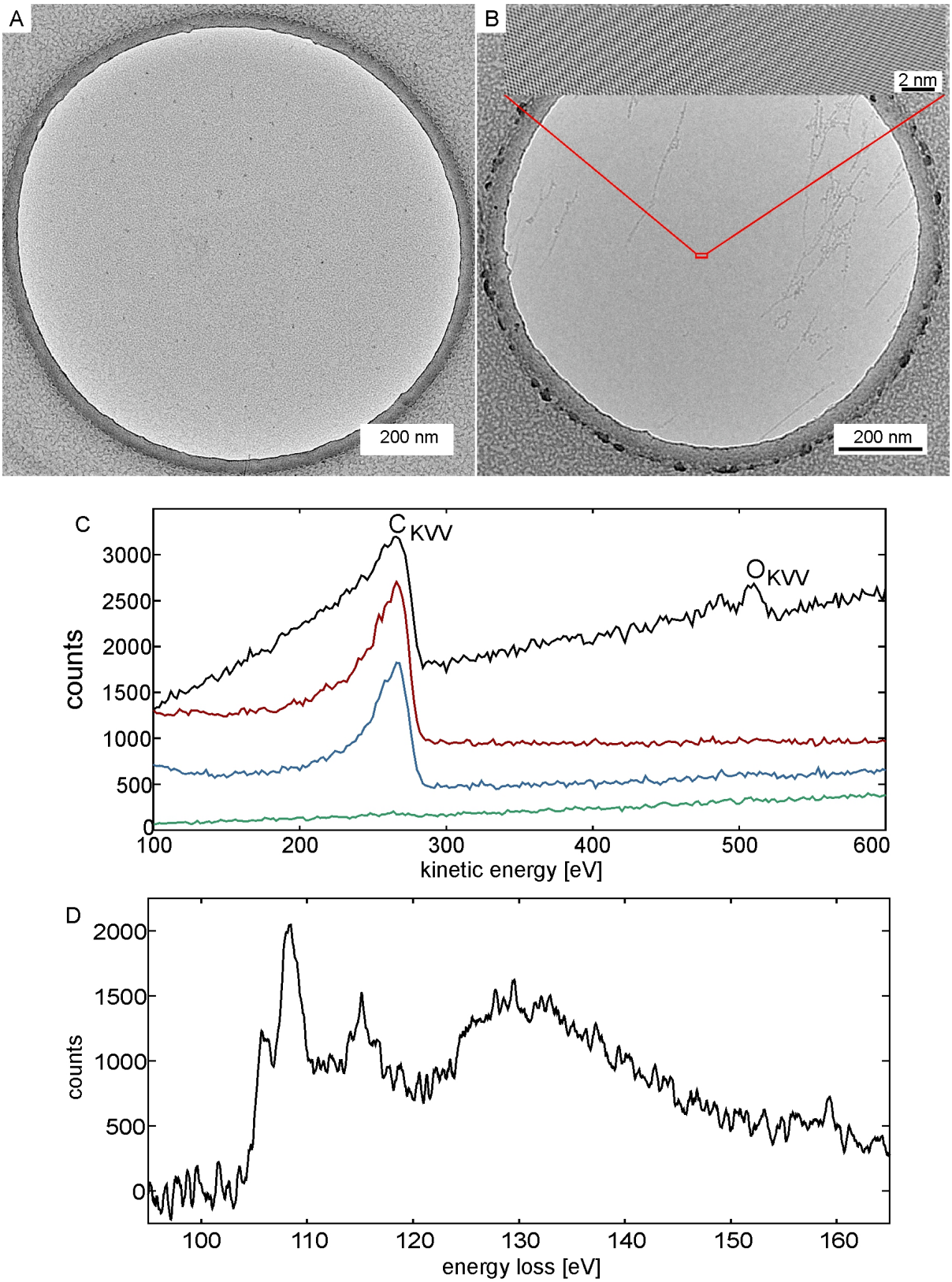

Fig. 1: HRTEM images of non-cleaned and dry-cleaned graphene(A and B respectively). Inset in (B) high resolution image of clean graphene. AE spectra (C) of a TEM grid (black), non-cleaned (red) and dry-cleaned graphene (blue) and vacuum (green). (D) EEL spectrum of residual contamination on dry-cleaned graphene demonstrating its Si content.