Graphene monolayers for electronic applications evaluated by optical light microscopy with polarization

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As candidate material for future electronics in the post-silicon era, graphene has attracted tremendous attention in recent years for its superior properties like high electrical conductivity with high intrinsic carrier mobility and ability to sustain extreme current densities.[1] Critical problems for the application in electronic devices have originated from the various defects like pinholes, multilayer islands, grain boundaries, and folds from the growth; cracks or residues from the transfer; etc. In this respect, a fast and simple characterization with optical light microscopy (OM) would be helpful for coarse initial evaluations of the G monolayer quality. We investigated here CVD-grown G monolayers after transfer on Si | 100 nm SiO_2 substrates from 5 different producers, applying bright field OM with and without polarization as well as dark field OM (light scattering at surface topographies). Bright field OM with polarization turned out as most useful providing much greater contrast for the various above-listed defects. Specific to each vendor, we found either more multilayer islands (Fig. 1), or more PMMA/ Cu residues (Fig. 2), as well as cracks and folds. All vendors grew graphene on Cu (Fig. 1 & 2). The IHP has recently demonstrated graphene CVD on Ge,[2] which generally exhibited no visible multilayer islands as well as much reduced folds (Fig. 3). Hence, such CVD-G monolayers grown on Ge might be favorable for next technological integration steps.

References

[1] K.S. Novoselov et al.,Nature 490(2012)192
[2] Dabrowski *et al. Scientific Reports* **6**(2016) 31639

Figures

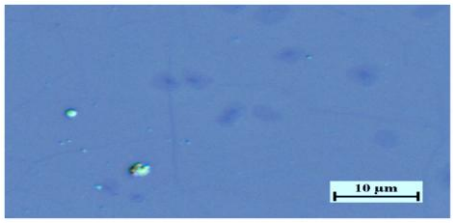

Figure 1: Bi-/ trilayer islands on CVD-G (grown on Cu).

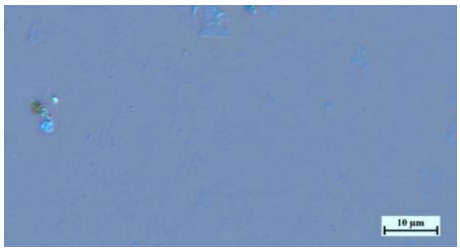

Figure 2: PMMA and Cu residues from transfer of CVD-G (grown on Cu)

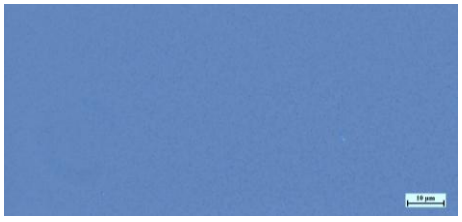

Figure 3: Nearly defect-free CVD-G monolayer (grown on Ge) after transfer