RAPID IDENTIFICATION OF GRAPHENE FLAKES: ALUMINA DOES IT BETTER

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Nowadays graphene is one of the hottest systems under investigation in materials science and condensed matter physics. The micro-mechanical exfoliation of HOPG yields to graphene flakes with various thicknesses that, once deposited on a dielectric substrate, can be rapidly identified by white light contrast analysis via an optical microscopy survey.
300 nm thick SiO_2/Si(100) is widely recognized as a good substrate to rapidly locate exfoliated graphene flakes. Very recently, it has been demonstrated that 72 nm thick Al_2O_3/Si(100) shows an optical contrast that is 3 times higher than the one observed on 300 nm thick SiO_2 [1].
We report a systematic investigation of the colour contrast (CC) of Graphene (one, two and three layers) on 50, 72 and 80 nm thick Al_2O_3/Si(100) and 100 and 300 nm thick SiO_2/Si(100) (Fig. 1, Fig. 2, and Fig. 3). The CC is determined by the analysis of optical microscopy images taken under white light illumination. A corresponding assignment of graphene in the single, double and tri layer phase is made with micro-Raman spectroscopy. A quantitative evaluation allows to conclude that the colour contrast between 72 nm alumina and graphene is significantly larger than the one between 300 nm silicon oxide and graphene (by a factor 2.2, 2.0 and 3.3 for the single, double and tri-layer graphene flakes respectively) (Fig. 4). Moreover, data indicate that, to increase the visibility, the use of a red or a green light is preferable [2].

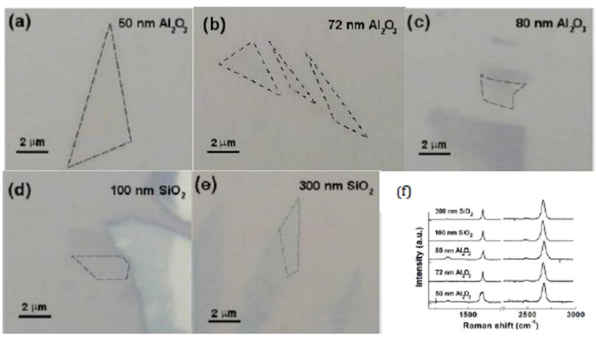

Figure 1: Confocal optical microscopy images of single layer graphene on (a) 50 nm Al_2O_3/Si(100), (b) 72 nm Al_2O_3/Si(100), (c) 80 nm Al_2O_3/Si(100), (d) 100 nm SiO_2/Si(100), and (e) 300 nm SiO_2/Si(100). (f) SLG micro-Raman spectra taken in the dashed regions of panels (a)-(e).

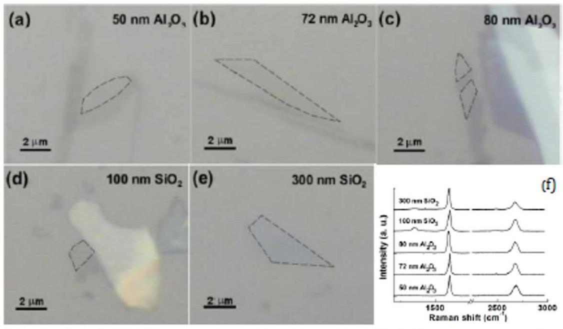

Figure 2: Confocal optical microscopy images of bilayer graphene on (a) 50 nm Al_2O_3/Si(100), (b) 72 nm Al_2O_3/Si(100), (c) 80 nm Al_2O_3/Si(100), (d) 100 nm SiO_2/Si(100), and (e) 300 nm SiO_2/Si(100). (f) BLG micro-Raman spectra taken in the dashed regions of panels (a)-(e).

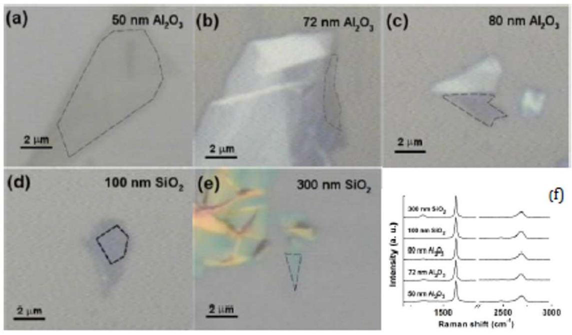

Figure 3: Confocal optical microscopy images of trilayer graphene on (a) 50 nm Al_2O_3/Si(100), (b) 72 nm Al_2O_3/Si(100), (c) 80 nm Al_2O_3/Si(100), (d) 100 nm SiO_2/Si(100), and (e) 300 nm SiO_2/Si(100). (f) BLG micro-Raman spectra taken in the dashed regions of panels (a)-(e).

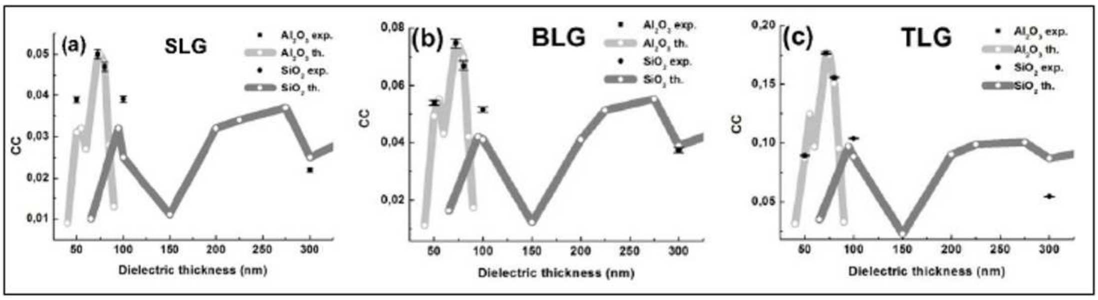

Figure 4: Colour contrast versus dielectric thickness. Full squares and circles are the experimental values for Al_2O_3 and SiO_2, respectively, for (a) SLG, (b) BLG, and (c) TLG. The light grey and the grey curves are the CC values calculated from the RGB components in the TCD maps by Gao (courtesy of Ren [1]) in the cases of Al_2O_3 and SiO_2 respectively.

References

[1] L. Gao *et al.*, ACS Nano, 2 (2008) 1625.
[2] P. De Marco *et al.*, Nanotechnology, 21 (2010) 255703.