Influence of the buffer layer properties on the intensity of Raman scattering of graphene

T. S. Perova[1], S. A. Dyakov[1], J. Wasyluk[1] , C.Q. Miao[2], and Y.-H. Xie[2]

1. *Department of Electronic and Electrical Engineering, Trinity College Dublin, Dublin 2, Ireland*
2. *Department of Materials Science and Engineering, University of California, Los Angeles, USA*

Using a model of oscillating dipoles, we simulate the intensity of the G-band in the Raman signal from structures consisting of graphene, separated by an arbitrary dielectric layer (or buffer layer) from a substrate. It is found that a structure with an optimized buffer layer refractive index and thickness exhibit a Raman signal which is nearly 50 times more intense than that from the same structure with a non-optimized buffer layer. A simultaneous presentation of Raman intensity of the G-band and optical contrast maps for a single layer of graphene, as a function of refractive index and buffer layer thickness is produced (Fig. (a)). This presentation enables selection of the buffer layer material in order to optimise Raman and optical microscopy imaging. The advantages of this technique, demonstrated at an excitation wavelength of 457 nm, is confirmed experimentally for two dielectric materials viz. SiO_2 and Al_2O_3 with different refractive indices and thicknesses. It has been also shown that for an SiO_2 buffer layer thickness in the range of 150–160 nm, substantial enhancement of the G-band intensity from a single graphene layer can be achieved, even at longer excitation wavelengths of 633 and 785 nm (see Fig. (b)).