Enhanced stability of metal depositions supporting plasma waves by graphene transfer

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The major problem to practical application of plasmonics devices is the chemically instability of the metals surfaces which are easily oxidize and degrading the plasmonics characteristics [1]. Here we use angle interrogation scheme of Surface Plasmon Resonance spectroscopy to study the stability of plasmonic material covered with graphene grown by CVD on copper foil [2]. Taking advantage of the high impermeability property of graphene to gases and liquids [3], we demonstrate that a graphene on metals substrates can be used to prevent it from chemical reactions and degradation of the adhesion of the metal deposition over the glass substrates. Raman spectroscopy has been used to verify the existence and quality of graphene after transfer process. Figure 1 show the Raman peaks of graphene as grown and after the transfer on gold. Raman peaks located at 1579 and 2691cm^{-1} are attributed to G and 2D peaks of graphene, thereby verifying that graphene has been transferred onto metal substrates.

The stability measurements where performed in atmosphere, and are based on the monitoring of SPR angle and full width half maximum (FWHM) during time. Our results, shown in Fig.2, demonstrate that graphene protected gold (Au) and silver (Ag) depositions exhibit greater stability as compared to unprotected samples (exposed to air), similar to the one associated to samples protected by typical OLEDs encapsulation technique [4]. We observed a shift in the SPR angle of about 0.005^0 for Ag /graphene and Au/graphene samples after 4 hours of observation, as shown in figure 2. Such a change is comparable to the zero angle determination and limits the time interval useful for the characterization of thin films in air. The presented stability enhancement is very important both for the graphene optical characterization [5] as well as to the use of graphene in biosensing application [6].

References

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Figures

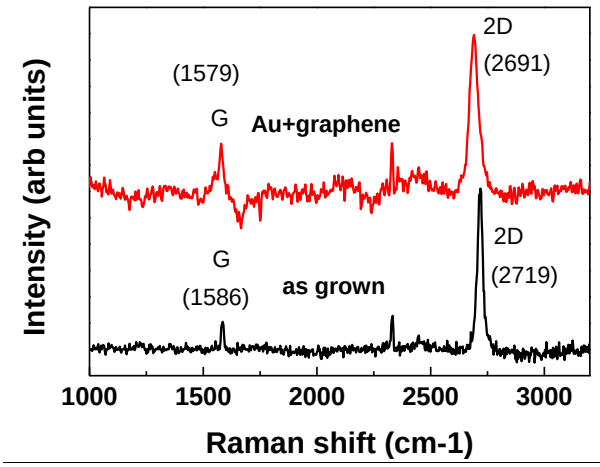

Figure 1: Raman spectra of as grown graphene on copper foil (below) and transferred graphene layer on Au thin film (above).

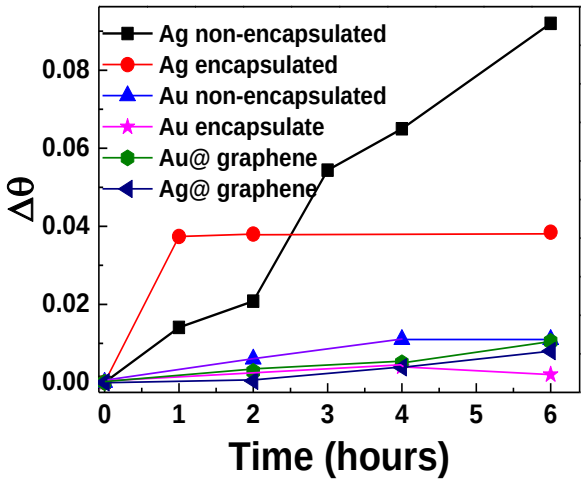

Figure 2: Stability investigation based on change in SPR angle as a function of time for protected and unprotected SPR substrate. Gold (Au) and silver (Ag) protected grpahene exhibit a stability similar to the substrates protected by OLEDs encapsulation technique.