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Graphene Decorated with Cu_xO and Ag Nanoparticles: Thin and Transparent Films Used as Surface-Enhanced Raman Scattering Substrates

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Surface-enhanced Raman spectroscopy (SERS) is a very useful technique to ultrasensitive sensing. It provides fingerprints-like information about molecules in a direct and non-destructive way. Nevertheless, the sensing potential of SERS is directly related to the materials used as substrates.[1] This work presents a series of nanocomposites of graphene decorated with copper and silver nanoparticles developed to be applied as SERS substrates. These nanocomposites were synthesized through in situ reaction by liquid-liquid interfacial route (LLIR-GQM).[2] Nanocomposites were obtained and processed in a two-phase system, containing water, toluene, $AgNO_3$, $Cu(NO_3)_2$, dispersion of graphene oxide (GO), and $NaBH_4$. Through modifications in the proportion of metallic precursors, we obtained hybrid nanocomposites of reduced graphene oxide (rGO) decorated with Cu_xO and/or Ag nanoparticles: rGOAg 1:1, rGOAg 1:4, rGOCuO 1:1, rGOCuO 1:4, rGOCuOAg 1:1:1, rGOCuOAg 1:4:1, and rGOCuOAg 1:1:4. UV-Vis and Raman spectroscopies show bands related to rGO and AgNPs. XRD shows peaks of metallic silver (fcc) and Cu_xO. SEM-EDS images show morphological differences among nanocomposites related to the variation in the proportion of copper and silver precursors, indicating the formation of "hot-spot" structures mainly in tri-component films. For SERS assays, rhodamine 6G was used as the probe molecule. As SERS substrate, the tri-component film rGOCuOAg 1:1:1 presented the best performance, with a sensitivity 10000 greater than the SiO_2 substrate and at least 10 times greater than the other nanocomposites. Through these outcomes, we demonstrate the essential role of the synergy among the components of the substrate in Raman scattering, while using Cu_xO nanoparticles, which are not commonly used in this application.

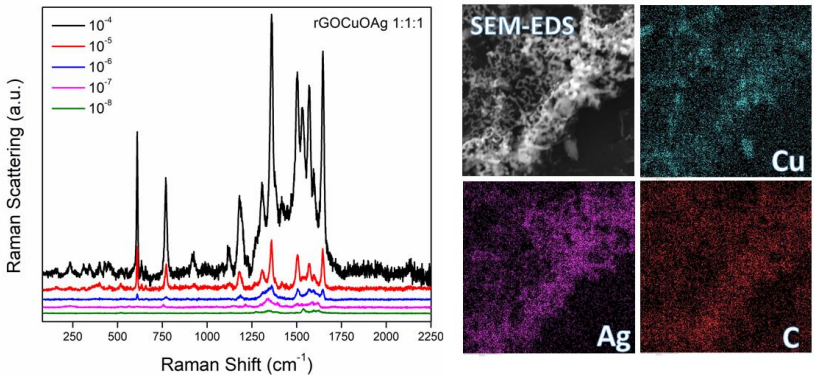

Figure 1. Raman spectra of rhodamine on rGOCuOAg 1:1:1 substrate and SEM-EDS images of rGOCuOAg 1:1:1.

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References

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