Novel hybrid nanocomposites based on Reduced Graphene Oxide decorated with Ag Nanoparticles for antibacterial textile coatings

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The manufacture of smart textiles possessing specific functionalities (i.e. flame retardancy, self-cleaning, antimicrobial), has recently attracted both for fundamental studies and textile industry applications, and has leaded to the development of new strategies aiming at addressing suitable technology for conveying such functionalities on traditional fabrics. Hybrid nanocomposites based on graphene (G) and inorganic nanoparticles (NPs) have attracted increasing interest for this technology purpose due to the multiple functionalities resulting from the merging of the intrinsic chemical and physical properties of the two components. G is a carbon scaffold with high chemical reactivity, thermal and electrical conductivity and (electro)catalytic activity. Inorganic NPs present multifunctionalities appealing for advanced textiles manufacture due to their high surface-active area that amplifies their unique chemical and physical properties with respect to bulk traditional additives and materials. In this work, original hybrid nanocomposites based on Reduced Graphene Oxide (RGO) decorated by plasmonic Ag NPs have been synthesized by a facile *in situ* colloidal approach in aqueous solutions. At first, RGO has been exfoliated and functionalized with the histidine (His) as biocompatible aromatic linker capable to bind both RGO, via π-π interactions, and the Ag NPs through coordination bonds. The Ag NPs have been synthesized on His-RGO from aqueous solutions by reduction of silver nitrate ($AgNO_3$) with trisodium citrate ($C_6H_5O_7Na_3$) and sodium borohydride ($NaBH_4$). The exfoliation and functionalization of RGO have been performed in His solutions at different pH, and, subsequently, Ag NPs have been synthesized at different RGO:$AgNO_3$ w/w, $AgNO_3$:$C_6H_5O_7Na_3$ and $NaBH_4$:$C_6H_5O_7Na_3$ molar ratio and pH. Investigation of the spectroscopic and morphologic characteristics of the prepared nanocomposites has been performed by means of UV-Vis absorption and Raman spectroscopy, TEM and SEM-EDS in order to identify the most suited conditions for achieving narrow NPs size distribution and high coating density of the sheets. The obtained His-RGO/Au NPs nanocomposites have demonstrated a good colloidal stability in water and have been found coated by monodisperse spherical Ag NPs, ca. 24 ± 4 nm in size, with a Localized Surface Plasmon Resonance absorption at 366 nm. Preliminary tests of the *in situ* antimicrobial activity of the His-RGO/Ag NPs, as coating of cotton fabrics, performed by following the EN ISO 20743:2021 protocol, have shown a significant antibacterial effect against *Escherichia coli*, higher than that found for the neat His-RGO based coatings.