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An eco-friendly and reusable antibacterial film-forming composite

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The growing awareness and environmental concerns have increased the demand for biocompatible and antibacterial materials for applications in biomedical, food packaging, water treatment, etc. This paper describes the development of an ecofriendly, transparent and reusable antibacterial film-forming composite. The composite essentially comprises of a biopolymer, silver nanoparticles (AgNPs) and reduced graphene oxide (RGO). Unlike conventional methods, the reduction of graphene oxide (GO) to RGO was done by exposing GO to sunlight (16 h) as an eco-friendly and energy efficient alternative. The inherent ability of RGO to reduce Ag^+ ion is exploited to produce well-dispersed AgNPs of tuneable size on the surface of RGO sheets [1]. A redox like reaction between RGO and Ag^+ ions resulted in the formation of well dispersed AgNPs on RGO sheets (RGO-Ag). Large area antibacterial films were fabricated by introducing RGO-Ag dispersion into protonated chitosan solution (2%) at 1:1 ratio. The careful evaporation of the solvent facilitated the formation of the film.The as-developed film was cross-linked by 5% tri-sodium citrate solution.

The composites were characterised by various spectroscopic and microscopic techniques. The enhanced antibacterial property of the film is demonstrated by disk diffusion test [2] using *Escherichia coli* (*E. coli*) as the model microbe.

RGO exhibits absorbance peaks at 260 nm and a shoulder at 302 nm, which corresponds to the π-π* transition of C-C bonds and n-π* transition of C=O bonds, respectively (Figure 1). The small hump around 400 nm is due to the surface plasmon resonance (SPR) absorption band of AgNPs. Formation of spherical AgNPs of around 70 nm on RGO-Ag is visible from Figure 2a. The enhanced antibacterial of ability of the nanocomposites is evident from the large zone of inhibition (Figure 2).

The film forming ability with high mechanical strength and enhanced antibacterial properties makes the composite a suitable candidate for diverse applications including food packaging and purification of water.

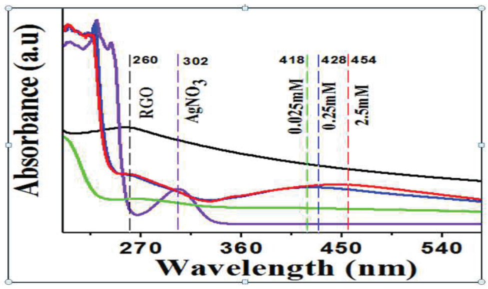

Figure 1: UV-Vis spectra of RGO and chitosan-RGO-Ag nanocomposites. Concentration of Ag^+ is varied (0.025 mM, 0.25 mM, 2.5 mM). Spectral positions are marked in the figure.

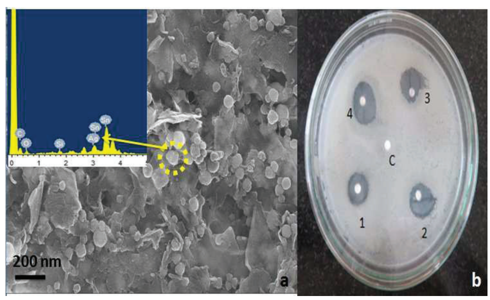

Figure 2: (a) FESEM micrograph of the chitosan-RGO-Ag nanocomposite. EDAX spectrum of the composite is shown the inset. (b): Photographs of disc diffusion assay represents the zone of inhibition. (1) only chitosan, (2) composite with (2)0.025 mM $AgNO_3$, (3) 0.25 mM $AgNO_3$, (4) 2.5 mM $AgNO_3$.

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References

1. T. Sreeprasad, S.M. Maliyekkal, K. Lisha, T. Pradeep, Journal of hazardous materials 186 (2011) 921-931.
2. A. Bauer, W. Kirby, J.C. Sherris, M. Turck, American journal of clinical pathology 45 (1966) 493.