

ABSTRACT

Graphene provides numerous possibilities for structural modification and functionalization of its carbon backbone. Localized magnetic moments can, as well, be induced in graphene by the formation of structural defects which include vacancies, edges, and adatoms. In this work, graphene was functionalized using germanium atoms, we report the effect of the Ge ad atoms on the structural, electrical, optical and magnetic properties of graphene. Reduced graphene oxide (rGO)-germanium quantum dot nanocomposites of high crystalline quality were synthesized by the microwave-assisted solvo thermal reaction. Highly crystalline spherical shaped germanium quantum dots, of diameter ranging between 1.6–9.0 nm, are anchored on the basal planes of rGO. The nanocomposites exhibit high electrical conductivity with a sheet resistance of up to $16 \Omega \text{ sq}^{-1}$. The electrical conductivity is observed to increase with the increase in Ge content in the nanocomposites. High defect-induced magnetization is attained in the composites via germanium adatoms. The evolution of the magnetic moments in the nanocomposites and the coercivity showed marked dependence on the Ge quantum dots size and concentration. Quantum confinement effects is evidenced in the UV–vis absorbance spectra and photoluminescence emission spectra of the nanocomposites which show marked size-dependence. The composites manifest strong absorption in the UV region, strong luminescence in the near UV region, and a moderate luminescence in the visible region.

Keywords

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