SUMMARY

Electrically conductive polycarbazole-titanium dioxide nanocomposite (PCz/TiO₂) have been synthesized for the first time by in-situ chemical oxidative polymerization of carbazole (Cz) with APS in the presence of titanium dioxide (TiO₂) nanoparticles. FTIR, SEM, TEM, XRD, TGA and DTA were used to characterize PCz/TiO₂ nanocomposites. The characterization results confirmed that there is a strong interaction between PCz and TiO₂ nanoparticles and the nanocomposites showed higher thermal stability than pure PCz. The nanocomposites showed electrical conductivity and isothermal stability in terms of DC electrical conductivity retention under ambient condition below 100°C. A nanocomposite based sensor was fabricated for the detection of aqueous ammonia, it was found that the resistivity of the nanocomposites increases on exposure to ammonia at room temperature (25°C) and there showed a linear relationship between the responses and the concentration of ammonia. The comparative antimicrobial activities of PCz, its PCz/TiO₂-7 nanocomposite and ciprofloxacin drug with different bacteria have also been studied.

Polycarbazole-titanium dioxide, (PCz/TiO₂-8) nanocomposite was synthesized for the first time by in-situ oxidative polymerization with APS as an oxidizing agent in the presence of TiO₂ nanoparticles and characterized by SEM, TEM, FTIR, DTA and TGA techniques. The results of analysis confirmed that the incorporation of TiO₂ in PCz indicating the formation of nanocomposite due to strong interaction between TiO₂ and PCz matrix responsible for enhancing the properties as compared to pristine, PCz. The PCz/TiO₂-8 nanocomposite was tested for antimicrobial activity and was found to exhibit activity against gram negative and gram positive strains at micromolar concentrations. The SEM and TEM results show that PCz has polymerized on the surface of the TiO₂. The four types of 3D molecular field descriptors or field points as extrema of electrostatic, steric, and hydrophobic fields are explained. These field points are used to define the properties necessary for a molecule to bind in a characteristic way into a specified active site. A molecular docking simulation was used to predict the modes of interactions of the drugs (PCz and PCz/TiO₂-8) with DNA. The molecular docking conclusion indicated that the modes of interactions between two (PCz and PCz/TiO₂-8) and DNA helix can be regarded as groove binding.
The nanocomposites, Poly(o-toluidine)-titanium dioxide (POT-TiO₂) doped with organic sulfonic acids (dodecylbenzene sulfonic acid, camphor sulfonic acid, and p-toluene sulfonic acid) were synthesized by in-situ polymerization of o-toluidine (OT) with TiO₂ nanoparticles. The thermogravimetric analysis (TGA) and differential thermal analysis (DTA), Fourier transform infrared (FTIR) spectroscopy, X-ray diffraction (XRD) analysis, transmission electron microscopy (TEM), scanning electron microscopy (SEM), were used to characterize DBSA/POT-TiO₂, PTSA/POT-TiO₂ and CSA/POT-TiO₂ nanocomposites. The characterization results demonstrated that the nanocomposites revealed superior thermal stability than that of pure POT. These results confirmed the inclusion of the TiO₂ nanoparticles in pristine POT signifying the development of nanocomposites as a result of the interaction between the TiO₂ nanoparticles and pure POT moiety accountable for higher thermal stability than that of pure POT. The nanocomposite display isothermal stability as well as electrical conductivity in terms of DC electrical conductivity retention under ambient condition below 90°C. The anthelmintic and antimicrobial and photocatalytic activities of pristine POT and its nanocomposites have also been studied with earthworms and the bacteria.

Here in the synthesis, characterization, and photocatalytic studies of cobalt selenide (CoSe) nanoparticles (NPs) are reported. The synthesized CoSe NPs were characterized using transmission electron microscopy and X-ray diffraction studies which showed that the NPs are highly crystalline, circular and having particle size of 20-25 nm in diameter. Furthermore, structural, optical, thermal and photocatalytic properties of the synthesized CoSe NPs were also evaluated. The TGA/DTA results revealed that the Co and Se are strongly interacting, which is also supported by the selective area EDAX analysis. The application of the synthesized CoSe NPs for an efficient photocatalysis of Rhodamine B (RhB) dye under UV light irradiation are investigated resulting in the productions of reactive oxygen species (ROS) by the CoSe NPs. Therefore, it is concluded that the synthesized CoSe NPs have great environmental significance based on the results. Moreover, the energy band gap as calculated by the Tauc relation was found to be in the range of Eg = 1.8 eV.