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Ultrafast dynamics at zinc-phthalocyanine/zinc oxide nanohybrid interface for efficient solar light harvesting near red region

Saleh A Ahmed[1], **Zaki S Seddigi**[1], **Abdallah Al-Masoudi**[1], **Rashad Khodary**[1], **Samim Sardar**[2] and **Samir Kumar Pal**[2]
[1]Umm Al-Qura University, Saudi Arabia
[2]S. N. Bose National Centre for Basic Sciences, India

Phthalocyanine based light harvesting nanomaterials are attractive due to their low cost, eco-friendly properties and sensitivity in the red region of the solar spectrum. However, for any practical application, phthalocyanines need to be chemically modified for anchoring groups with wide-band semiconducting nanomaterials. In this paper, zinc phthalocyanine (ZnPc) were functionalized with two carboxyl group containing biologically important ligand tartrate, using a facile wet chemistry route and duly sensitized zinc oxide (ZnO) in order to form nanohybrids for the application in photocatalytic devices. The nanohybrids have been characterized by high-resolution transmission/scanning electron microscope (HRTEM, FEG-SEM), X-ray diffraction (XRD), steady-state infrared/UV-VIS absorption and emission spectroscopy for their structural details and optical properties, whereas, the ultrafast dynamical events which are the key for understanding the photocatalytic activities are monitored using picosecond-resolved fluorescence techniques. More specifically, vibrational spectroscopy (FTIR) unravels covalent connection of ZnPc with the host ZnO nanoparticles via tartrate ligand. The efficiency of the material on photocatalysis under red light irradiation is found to be significantly enhanced compared to bare ZnO. A mechanistic pathway for the formation of photoinduced reactive oxygen species (ROS) in aqueous medium for the photocatalytic efficacy was investigated. In order to make a prototype for a potential application in a flow device for water decontamination, we have sensitized ZnO nanorods (ZnO NR) with tartrate functionalized ZnPc. The molecular proximity of ZnPc at the ZnO surface has been confirmed by picosecond resolved Förster resonance energy transfer (FRET) from intrinsic emission of surface defect of ZnO NR to the attached ZnPc. The excited state electron transfer dynamics as revealed from picosecond resolved fluorescence study (TCSPC) is in good agreement with the enhanced charge separation at the interface of the nanohybrid. Enhanced photoresponse, wavelength dependent photocurrent of the sensitized nanorods and photodegradation of a model water pollutant in a prototype device format confirm the potential use of the nanohybrids in water purification.

saleh_63@hotmail.com

Applications of nanotechnology in dentistry benefits and drawbacks

Wafaa A Khalil
King Abdulaziz University, KSA

Applications of nanotechnology for dental biomaterials are growing rapidly. Nanodentistry includes diagnosis and treatment of oral cancer, prevention of plaque accumulation, treatment of teeth hypersensitivity, replacing fractured enamel, restoration of carious teeth and root canal filling. Applying nanotechnology for restorative materials improved their physical and esthetic properties, adhesion and sealing that prolonged their durability. Coating implant with nanomaterial increased their wettability, antibacterial and osteoinductive function. Using Nanobiomaterials like anesthesia, needles, sutures and bone-replacing materials in surgeries facilitated non-invasive procedures without postoperative pain and complications. In spite of nanobiomaterials are non cytotoxic and do not cause health hazard, Nanotechnology did not improve their pyrogenicity. The biocompatibility of the biomaterial depends on their chemical components. Some studies showed that inhalation of Nanodental material dust penetrate alveoli and transported by blood to the liver and spleen. Nanobiomaterial used in surgeries are carried by the blood to the distant body organs and accumulated as non-degradable toxic components that are capable to cause harm to distant organs like lung, liver, spleen and kidney.

dr.wafa_endo@hotmail.com