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Solar Photocatalytic Removal of Organic Dyes and Toxic Metals from Industrial Wastewater using Graphene Supported Inexpensive Semiconductors

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Use of the solar radiation in conjunction with heterogeneous semiconductor photocatalysts is one of the alternative approaches in the purification of industrial wastewater containing dye and toxic metal ions. Photocatalytic properties of various inexpensive and chemically stable semiconductors, including Cu2O, ZnO, SnS, gC3N4, BiOCl etc in their nanostructured forms have been found to be efficient materials with potential in water purification technologies. Their nano-carbon composites, with Graphene or reduced Graphene oxides have shown reasonable efficacy of industrial wastewater treatment through size and shape modulation effect of the catalysts by the virtue of effective electron transfer channel provided by the 2D material. Graphene being also capable of non-porous surface adsorption and an adsorption facilitated by p-p interaction has been used in a reduced graphene oxide hydrogel (rGOh) form along with the visible light responsive semiconductors in the treatment process. Nanostructured BiOCl prepared in hydrothermal route with nano-morphological variations and non-metal doped gC3N4 are used as the visible light responsive photocatalysts (vlsPC) in the reduction of heavy metal ions Hg2+, Pb2+ and Cr4+ as well as in the removal of two potential textile industry dyes, Rhodamine B and Methylene blue. The adsorption-photocatalytic performance of rGOh/vlsPCs shows that heavy ion concentration is reduced below 40% in about 90 minutes of irradiation by simulated solar light. Dyes play a combined role of sensitizer and pollutant. Photoluminescence absorption spectra suggest that the dye-chromophores undergo cleavage in the visible photon energy range of 450-600nm. The developed graphene supported photocatalysts have been successfully tested with industrial effluent water samples as well under natural solar irradiation. A detailed optimization of such system is.

Biography

Abhijit Ray is an Associate Professor at the Pandit Deendayal Petroleum University, India and currently heading the Department of Solar Energy. After completing his PhD in 2003, he was post-doctoral researcher at Variable Energy Cyclotron Center of Department of Atomic Energy (India). In 2004 he joined Birla Institute of Technology, Mesra as Lecturer in Physics before joining PDPU as Assistant Professor in 2007. He has been visiting professor at Nagoya Institute of Technology, Japan during 2015-16. His current research works are focused to the development of earth-abundant and eco-friendly semiconducting thin films, nanostructures and devices for photovoltaic, photo-electrochemical energy conversions and capacitive energy storage applications. He has been principle investigator in various externally funded research projects from DRDO, DST and MNRE; published more than 75 papers in peer reviewed journals and filed three Indian patents.

Publications

- Role of nanowire length on the performance of self-driven NIR Photodetector based on mono/bi-layer graphene (camphor)/Si-Nanowire Schottky junction
- Comparative study of heat transfer characteristics of a tube equipped with X-shaped and twisted tape insert
- Investigation of spray pyrolyzed copper oxide as a photocathode in photoelectrochemical energy conversion
- Photoelectrochemical Water Splitting Characteristics of Electrodeposited Cuprous Oxide with Protective Over Layers
- A peel-off graphene sheet fabricated from camphor

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