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A decade of nanosize TiO_2 material design for a novel chemical sensor

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Nanosize TiO_2 material was succesfully designed and fabricated as a chemical oxygen demand (COD) sensor after more than a decade of intensive research. The material was extracted from iron sand (ilmenit natural minerals) and designed by M-N (metal-nitrogen) double doped TiO_2 for degradation of organic pollutants under visible (Sun Harvesting) irradiation. TiO_2 film was immobilized on an ITO (Indium Tin Oxide) glass for electrode preparation. The film was applied by a dip coating technique in a hydrothermal sol-gel system and subjected to a heat treatment. Characterization of the film electrode by XRD, AFM, BET, LSV and MPA methods revealed the occurence of anatase form and about 10 nm in crystallite size; having three dimensional profile and roughness with height of typically 10 nm; and surface area of 58 m^2/g. The film was then employed as a working electrode in a photo electrochemical system (PES). This PES generated a photocurrent that was proportional to the organic chemical concentration in the water sample. Integration of the photocurrent versus time gives a charge (Q) that represents the event of complete mineralization of organic chemical in the TiO_2 surface and can be correlated to the COD of measured water. This system has a potential to be develop as a novel COD sensor.

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Development of mesoporous bioactive glass for *in vitro* tissue regeneration, drug release studies, cell cycle analysis and *in vivo* compatibility

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In recent years bioglass have gained popularity due to its excellent bioactivity and biocompatibility. Bioactive glass when implanted in body, bonds with living tissues directly. They have shown to enhance bone cell responses such as cell proliferation, cell adhesion, calcium deposition and alkaline phosphatase activity. Porous bioactive glass exhibit much enhanced biocompatibility and bioactivity due to greater specific surface area and pore volume. This study was aimed to synthesize a novel, more effective bioactive and biocompatible bioglass. In this work we report synthesis of mesoporous bioglass (MBG) by using facile sol-gel method. Polyethylene glycol (PEG 6000) was used as a soft template. The as-synthesized MBG samples were characterized by X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), Energy dispersive X-ray spectroscopy (EDX) and Brunauer Emmett Teller (BET). The as-prepared samples had spherical morphology as confirmed by SEM with size 1μm±0.2. Furthermore, these samples were evaluated for cell proliferation, protein adsorption studies, cell cycle analysis and drug release studies. They showed better biocompatibility as confirmed by the formation of hydroxyapatite (Hap) layer on glass surface when soaked in simulated body fluid (SBF). MBG caused no inflammation during *in vivo* insertion and remained non-cytotoxic to normal cells. Drug loaded MBG showed a sustained release for more than two weeks.

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