SYNTHESIS AND PHOTOCATALVTIC ACTIVITY OF SUPPORTED CARBON DOPED AND NITROGEN/CARBON CO-DOPED T1O2 NANOCOMPOSITES

Akhona Gura, **Tijani JO**, Fatoba OO, & Petrik LF

Environmental and Nanosciences Research Group, Department of Chemistry, University of the Western Cape, Bellville, South Africa

Abstract: The presence of persistent organic contaminants such as pharmaceuticals, personal care products, pesticides, and dyes in water sources has been recognized as a major problem worldwide. Exposure to these contaminants via drinking water or consumption food irrigated with such water may result to short and long-term health effects on humans and aquatic organisms [I], Conventional wastewater treatment processes such as physical, chemical, and biological methods are not designed for the removal of these persistent organic pollutants in water. In order to comply with the environmental regulatory framework, there is need to develop advanced treatment techniques. Among the advanced oxidation process, heterogeneous photocatalysts such as Titanium dioxide (Ti02) have been identified as a possible solution to water pollution due to unique characteristics such as low cost, photochemical stability, and strong oxidizing power. However, post-filtration of the suspended Ti02 particles after water treatment is time consuming and creates additional cost thus limits its industrial applications. In order to address the post-separation issue, this present study developed carbon doped Ti02 (C-Ti02) and nitrogen-carbon co-doped Ti02 (N- C-Ti02) nanocrystals on a titanium mesh substrate using a sol-gel method.

The influence of calcination temperature (300, 350, 400°C) at a constant heat ramping rate of 35 °C/min on the formation of Ti02 nanocrystals was explored. Three different loading of NlliNOj (1 %, 3 % and 5 %) were immobilized on optimum carbon-doped $Ti0_2$ nanocrystals at the same constant heat ramping rate. The photocatalytic activity of the synthesized catalysts were evaluated using methylene blue under visible light irradiation for 2 hrs. The' synthesized nanomaterials were characterized by the following analytical techniques: High Resolution Transmission Electron Microscopy (HRTEM), High Resolution Scanning Electron Microscopy (HR-SEM), Energy Diffraction Spectroscopy (EDS), Selected Area Electron Diffraction (SAED), Fourier Transform Infrared spectroscopy (FTIR), Photolumincsccncc spectroscopy (PL) and X-ray diffraction (XRD), The XRD patterns and HRTEM micrographs showed that "both the supported C-TiO2 and C-N-TiO2 nanocomposites were purely anatase phase irrespective of the calcination temperature, ramping rate and NH,NOj loading rate. The PL indicated shifting of absorption band threshold of N-C-TiO_2 nanocompositcs toward the visible region (460 nm) compared to 390 nm for C-TiO2 nanocrystals. A maximum removal efficiency of 64 % and 70 % was achieved for C-TiO2 nanocrystals and N-C-TiO2 nanocompositcs respectively. The 6% increment in MB removal rate by N-C-Ti02 nanocompositcs may be attributed to the doping effect of nitrogen as evidenced in the PL result. This study has demonstrated that visible light active C-TiO2 nanocrystals and C-N-TiO2 nanocomposites can be successfully synthesized and supported on a titanium mesh wire using a sol-gel method.

Keywords: TiO_2 synthesis, sol-gel. titanium mesh, calcination temperature, methylene blue.