ABSTRACT

Layered titanate nanotubes (TNTs) and titanate nanoribbons (TNRs) were synthesized via hydrothermal treatment from commercial TiO$_2$. Formation of nanotubes and nanoribbons were monitored by varying the hydrothermal reaction temperature and time. The two parameters hydrothermal reaction temperature and time was 100°C for 24h/72h, 150°C for 24h/72h and 200°C for 24h/72h. The morphology, structure and optical properties were systematically analyzed, with samples are characterized by TEM, XRD, XPS, SEM, N$_2$ adsorption-desorption isotherm (BET) as well as Raman, FT-IR and UV-Vis/DR spectroscopy. The study revealed that reaction temperature is the parameter for morphological control of the product. The Na$_x$H$_{2-x}$Ti$_3$O$_7$·nH$_2$O nanotubes and nanoribbons comprised a layered nanosheet framework with sodium and hydrogen cations interspersed between the sheets. Structure and physical properties of TNTs and TNRs are summarized. Further, dense products are obtained by increase the reaction time for the same temperature. The photocatalytic activities were assessed under UV light by degradation of rhodamine B and methyl orange aqueous solution. Results revealed that, degradation of TNTs and TNRs was observed, after samples annealed once at 400°C, which is due to occurrence of phase transformation from titanate to anatase TiO$_2$ and TiO$_2$(B) respectively.
Stabilized mesoporous TiO$_2$ was synthesized by evaporation induced self assembly (EISA) method and mechanically incorporated into single-walled carbon nanotubes (SWCNT) with different ratios. The physicochemical properties of the nanocomposites (mesoporous TiO$_2$/SWCNT) materials were investigated by Brunauer-Emmett-Teller (BET) measurement, X-ray diffraction (XRD), transmission electron microscopy (TEM), energy dispersive X-ray (EDX), photoluminescence (PL) and ultraviolet-visible (UV-Vis) spectroscopy measurements. The catalytic activity of mesoporous TiO$_2$ and nanocomposites were assessed by examining the degradation of rhodamine B as model aqueous solution under visible light. The formation of improved interface between mesoporous TiO$_2$ and CNT provides the number of active sites with viable surface area, which was in favour of the separation of electron-hole pairs and lowered the efficiency of their recombination. Hence, CNTs are facilitating the photocatalytic activity of mesoporous TiO$_2$ in the degradation of rhodamine B efficiently. Results indicate that the existence of strong interaction between CNT and mesoporous TiO$_2$ phases able to develop unique electron transfer properties, which leads to the formation of more OH$^*$ in the system, thus increase the efficiency of the photocatalytic effect.