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## **Preparation of Ag Doped Black TiO<sub>2</sub> Nanotubes (AgBTNTs) via Electrodeposition**

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### **Structured Abstract**

**Background:** Black titanium dioxide nanotubes (BTNTs) has emerged as a promising photocatalyst, garnering attention for its extended absorption spectrum into the visible light range of the solar spectrum. The motivation behind Ag doping lies in its ability to create a Schottky barrier at the metal-BTNTs interface. This barrier effectively hinders the recombination of electrons and holes, a critical process that could otherwise diminish the photocatalytic efficacy of BTNTs. Additionally, the deposition of Ag onto BTNTs serves to narrow the bandgap, further retarding the recombination of electron-hole pairs. The synergy between BTNTs and silver doping presents a promising avenue for improving photocatalytic technologies and finding applications in various environmental and energy-related domains.

**Methods:** Ag loaded TNTs were synthesized using the electrochemical deposition method in an ethylene glycol solution containing 0.09 wt% AgNO<sub>3</sub> (labelled as AgTNT). Simultaneously, a cathodic potential of 20 V was applied to electrochemically reduce TNTs in an ethylene glycol solution containing 0.27 wt% NH<sub>4</sub>F (labelled as BTNTs). The same configuration, employed in previous samples, was adopted in an ethylene glycol solution containing 0.09 wt% of AgNO<sub>3</sub> and 0.27 wt% NH<sub>4</sub>F, and it was labelled as AgBTNTs. The samples were further characterized for XRD, FESEM and EDX.

**Results:** The XRD analysis for AgTNTs and AgBTNTs showed sharp diffraction peaks at  $2\theta = 25.4^\circ, 38.5^\circ, 48.1^\circ, 55.1^\circ, 63.0^\circ, 68.7^\circ$ , (JCPDS 21-1272) corresponding to the crystallographic orientations of (101), (004), (200), (211), (204), and (116), respectively, indicating the presence of TiO<sub>2</sub>. Ag (111) peak was found to be overlapped with the TiO<sub>2</sub> peak at  $38.2^\circ$ . FESEM analysis revealed deposited silver particles adhering to the TiO<sub>2</sub> nanotubes. The Energy Dispersive X-ray (EDX) analysis conducted on AgBTNTs confirmed the presence of element titanium (Ti), oxygen (O), and silver (Ag). This analysis serves as conclusive evidence that silver was successfully deposited onto the surface of the BTNTs through the electrochemical reduction.

**Conclusion:** In summary, the preparation of AgBTNTs via the electrodeposition technique is a successful one and this material could serve as a prospective candidate for various applications, particularly in the field of photocatalysis.

**Keywords:** silver, reduction, titanium dioxide, band gap

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