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## **Influence of zirconium dioxide and titanium dioxide binders on the photovoltaic performance of dye sensitized solar cell tungsten carbide nanorods based counter electrode**

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### **Abstract**

A facile hydrothermal method to synthesize tungsten carbide nanorods (WC-NRs) with mixture of zirconium oxide (ZrO<sub>2</sub>) and titanium dioxide (TiO<sub>2</sub>) materials for counter electrode (CE) in dye sensitized solar cell (DSSC) application is described. The synthesized materials were characterized by suitable analytical techniques such as X-ray diffraction (XRD), field emission scanning electron microscopy (FESEM), transmission electron microscopy (TEM), Brunauer-Emmett-Teller (BET) surface area analysis and energy dispersive spectra analysis (EDS). The electrochemical behavior of WCNRs, WCNRs-ZrO<sub>2</sub>, WCNRs-TiO<sub>2</sub> and WCNRs-ZrO<sub>2</sub>-TiO<sub>2</sub> modified counter electrodes were studied using electrochemical impedance spectroscopy (EIS) techniques. The DSSC assembled with the WCNRs-ZrO<sub>2</sub>, WCNRs-TiO<sub>2</sub>, WCNRs-ZrO<sub>2</sub>-TiO<sub>2</sub> based counter electrode demonstrated an enhanced solar to electrical energy conversion efficiency (2.29%, 1.59%, 1.92%) compared to that of binder free WCNRs (0.59%), due to the increasing bonding strength of material to substrate. The enhanced solar energy conversion efficiency demonstrated by the WCNRs-ZrO<sub>2</sub> makes it a promising candidate to Pt-free DSSC.

**Keywords: Tungsten carbide, Nanorods, Counter electrode, Solar Energy, Binder**

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