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Peculiar characteristics in electrical conductivity of WO3 incorporated TiO2

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It is known that the incorporation of tungsten ions (W6+) into the crystal structure of TiO2enhances the electrical conductivity and its performance as a photocatalyst for water cleavage. Here we report the variation of electrical conductivity with the percentage of WO3 incorporated in to TiO2and a peculiar conductivity transition at high temperature.

TiO2 (rutile structure) was doped using WO3 (0.1%, 0.2%, 2% and 10% by weight) as the dopant precursor and by the method of high temperature (1100oC) diffusion. Doped samples were compressed (~400 atm) between carbon electrodes to make pellets and the pellets were sintered overnight at 130oC in a vacuum The variation of electrical conductivity of each sample with temperature was studied.

For each sample, the conductivity varies according to well known Arrhenius type relation. The conductivity rapidly increases at lower dopant concentrations up to 2% and then slowly decreases with the dopant concentration. The highest conductivity (8.3x10-4-1cm-1 at 210oC), which is about six orders of magnitude higher than that of the undoped sample, is obtained when the dopant concentration is about 2%. The activation energy also varies with the dopant concentration. The lowest activation energy (0.6 eV) is measured when the dopant concentration is 0.2%. However, at high temperatures (>215oC) a conductivity transition is observed and the conductivity is decreased by two orders of magnitude.