Meetings International SciTechnol

J Nanomater Mol Nanotechnol 2018, Volume: 7
DOI: 10.4172/2324-8777-C4-030

International Conference on

NANOTECHNOLOGY AND NANOENGINEERING

July 16-18, 2018 | Paris, France

Dye-sensitized self-cleaning and anti-microbial fabric based on nanoparticles of TiO_2 adsorbed and dyed cotton

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This research has the distinct advantage of absorption of solar radiation in the entire visible region and dye sensitization of wide band gap semiconductors to separate electron-hole pairs which would otherwise recombine without being able to do a useful work. The electrons injected into the conduction band of TiO_2 are expected to reduce oxygen giving reactive oxygen species which would then destroy the stain and microbes present on the cloth. The oxidized dye molecules are brought back to their neutral state by injecting electrons from the stain molecules and microbial cells and thereby effecting their oxidative degradation. This novel concept of using dye sensitized self-cleaning fabrics makes use both dye and the semiconductor particles for stain removal and microbial cell destruction, whereas those self-cleaning fabrics developed so far only make use the electron-hole pairs separated in the semiconductor particles, usually TiO_2, due to ultraviolet excitation of valence band electrons to the conduction band of the semiconductor. Most customers expect the garments to perform minimum of 30 washes, every time an average garment washed with full wash load, the amount of water used for its lifetime is 75 gallons. 90% of the stains can be removed from the clothes only at 40° C, and the power consumption due to washing for garment is around 5.9 kW h. These developed self-cleaning fabrics can address the issues of power and water savings, thus they would be helpful in a sustainable manner.

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