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## High efficient Ag/TiO<sub>2</sub>/Graphene composite material by Atmospheric Pressure Plasma Jet for photocatalytic applications and water treatment

Houssam Fakhouri<sup>1</sup>, Tao Peng<sup>2</sup>, Abhay Jaiswal<sup>1</sup>, Jerome Pulpytel<sup>1</sup>, Jerald Lalman<sup>2</sup>, Farzaneh Arefi-Khonsari<sup>1</sup>

<sup>1</sup>CNRS-UPMC, Paris, France <sup>2</sup>University of Windsor, Ontario, Canada

houss.fakhouri@gmail.com

We propose a strategy to develop a Ag/TiO<sub>2</sub>/graphene (Ag/TiO<sub>2</sub>/G) nano-sandwich structure via coupling Ag-TiO<sub>2</sub> anatase composite coating with reduced graphene oxide nano-sheets. The new photocatalyst can show high visible-light efficiency in degrading recalcitrant chemicals in drinking water supplies. Titania can be modified with silver to increase the lifetime of the photo-excited electrons and holes. Photocatalytic TiO<sub>2</sub> and Ag doped TiO<sub>2</sub> coatings were deposited by injecting liquid precursor of Ti (with and without silver) in the after-glow of an Atmospheric Pressure Plasma Jet APPJ under different conditions of plasma and Ag% (concentration of silver 0 to 7 %). The technique leads to an interesting heat transfer phenomena to tailor the physicochemical properties of the coatings and to control the diffusion of silver in the host material (TiO<sub>2</sub>/G) which can optimize the doping sites in the composite material. The morphology, phase structure, chemical composition and photocatalytic properties of the coatings have been studied. Significant control of the porosity and crystallinity was achieved by varying the deposition parameters such as the plasma energy and substrate temperature. The results showed significant improvement in the photo activity under UV and visible irradiation for an optimal concentration of silver. Overall, atmospheric pressure plasma jet applied for TiO<sub>2</sub>/Ag thin coatings has shown a unique and highly desirable control over several important physical characteristics, which can be beneficial for many optoelectronic and photocatalytic applications. The deposited coatings presented a high porosity to give a unique advantage of the effect of silver diffusion for photocatalytic and anti-bacterial applications. The process can be applied to treat photocatalytic membranes which can efficiently combine filtration and photocatalysis for water treatment and for other self-cleaning surfaces, it can be easily integrated into existing production lines to treat complex 3D shapes.

### Keywords

Photocatalytic membrane

TiO<sub>2</sub>/Graphene

Atmospheric pressure plasma jet