**Fabrication of Pd-TiO2 nanotube junctions with enhanced photocatalytic activity via Atomic Layer Deposition for organic pollutants degradation**

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The design of nano-structured heterogeneous catalytic junctions with high interface to volume ratio and discrete surface distribution is critical to promote the photoelectron activity in the catalytic degradation of organic pollutants [1, 2]. In this work, photocatalytic palladium-titanium dioxide nano-junctions were fabricated via Atomic Layer Deposition (ALD) of palladium nanoparticles over the surface of titanium dioxide nanotubes synthetised by electrochemical anodization [3, 4].

The morphological and chemical properties of the supported Pd nanoparticles, and therefore the catalytic interface of Pd-TiO2 junctions, were controlled by the ALD process and correlated to the catalytic performance. The Pd catalytic interface and resulting active site density was tuned by controlling the nanoparticle growth and coalescence via ALD, leading to Pd-TiO2 junctions with distinctive morphological aspects. The chemical composition of the catalytic junction was investigated to evaluate the role and the impact of the noble metal/metal oxide catalytic interface on the photo-induced degradation of Persistent Organic Pollutants (POPs).

The visible light response of the Pd-TiO2 junctions was attributed to the Surface Plasmon Resonance effect [5] and correlated to the variation of the catalyst morphological aspect tuned by the ALD deposition. Uniform, discrete distribution of Pd nanoparticles with diameter lower than 5 nm led to high catalytic interface to deposited volume ratio.

The nano-engineered Pd-TiO2 junctions showed enhanced photocatalytic activity towards the degradation of methylene blue selected as a model contaminant. The photocatalytic efficiency of Pd-TiO2 junctions in the degradation of organic pesticides was further assessed on 2,4-dichlorophenoxyacetic acid, revealing a kinetic constant 4.5 higher than as-annealed anatase TiO2 nanotubes.

The optimisation of nano-interfaces combined with the design of well-defined catalytic junctions obtainable by a scalable, accurate deposition technique such as ALD represents a promising route to develop novel photoactive devices with high performance and minimum noble-metal loading.

**References**

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