Scaling approach of self-supported photocatalytic systems based on commercial titania and graphene filaments from thermal material extrusion

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Abstract
Photocatalytic heterostructures that combine carbon and titania materials have a significant impact on addressing environmental challenges and advancing renewable energy technologies. The material thermal extrusion technique has emerged as a promising method for printing 3D porous membranes and optimizing their morphology and composition.

Titania is one of the primary photocatalysts used in photocatalysis due to its stability and excellent absorption over a large part of the solar spectrum. However, the efficiency of titania is limited by its poor visible light absorption and quick charge recombination. To overcome these challenges, carbon materials are integrated into the heterostructures, offering high electrical conductivity, and extending light absorption into the visible range. This integration results in improved charge transfer kinetics, thereby increasing the efficiency of photocatalysis.

Material thermal extrusion is a versatile method used to fabricate heterostructures with well-defined morphologies and interfaces. This process involves the 3D printing of composite functional commercial materials, produced by COLFEED4Print S.L. in Spain. Material thermal extrusion is cost-effective and scalable while providing the ability to produce complex architectures with an enhanced active surface.

The resulting heterostructures exhibit excellent photocatalytic activity, stability, and recyclability, making them ideal candidates for a wide range of applications, such as environmental remediation and solar energy conversion. By incorporating material thermal extrusion in heterostructure 3D printing, we can further optimize component dispersion and enhance interfacial contact as we can see in the image below.

Figures

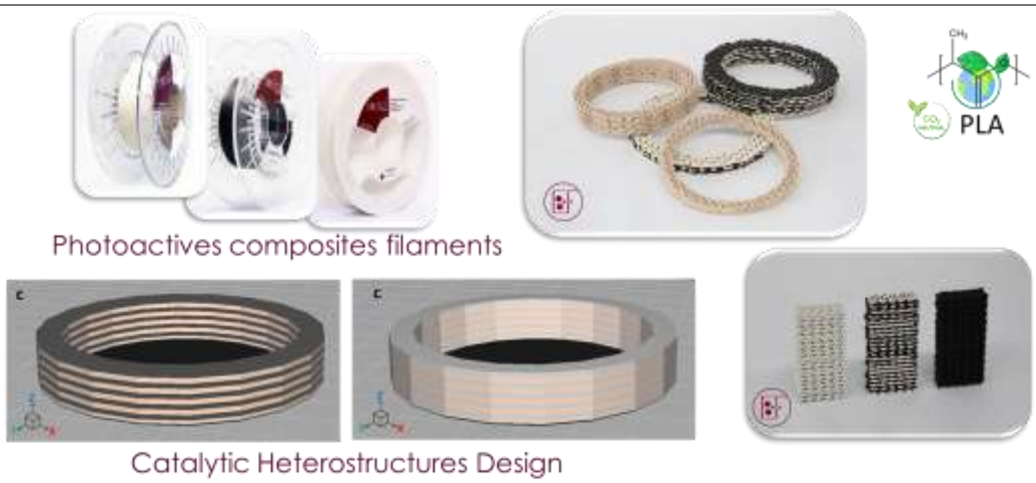

Figure 1: Example of a self-supported heterostructure based on MTE in water treatment for functional filaments based on titania and graphene nanoparticles.