Photoresponse of TiO_2-based structures prepared by different additive manufacturing techniques

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Abstract

TiO_2 coatings with porous microstructures and high specific surface area are highly on demand for applications involving photoactivity phenomena such as solar cells or photocatalytic degradation.
Many attempts to improve the photoresponse of the TiO_2 coatings are based on strategies aim at induce an enhanced reactant–catalyst contact through the design of complex structures with large surface-to-volume ratio. The TiO_2 structuring and photoactivity can be controlled by tuning the semiconductor physical properties (particle size, crystalline phase, preferred orientation) but also by shaping the TiO_2 material host.
Additive manufacturing (AM) processes to build complex shapes are emerging alternative technologies for ceramic manufacturing due to the first economically profitable industrial applications. The specific properties of the materials fabricated by AM techniques such as Inkjet Printing (IJP) or Fused Filament Fabrication (FFF) in many cases are similar to the corresponding ones of commercially available ceramic-based materials fabricated by other methods. Those printing technologies allow manufacturing of multilayer patterns and/or pieces using advanced materials that are superior to traditional ones.
In this work, the emphasis is placed on the fabrication of ceramic TiO_2-based materials with complex geometries and high specific surface area. A technological approach based on techniques such as IJP and FFF is followed to shape the ceramic semiconductor structure. The suspensions/inks used in the manufacture of samples are prepared with TiO_2 nanoparticles (Aeroxide P25) and optimized by a colloidal approach. A post-thermal treatment is occasionally applied to ensure consolidation of the materials. Microstructural properties and photoresponse of the samples will be presented.

References

[1] A.Sangiorgi et al. 3D printing of photocatalytic filters using a biopolymer to immobilize TiO_2 nanoparticles. J. Electrochem. Soc., 166(5),(2019) pp. H3239-H3248

Figures

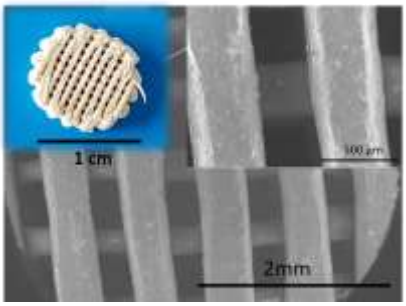

Figure 1: Picture and micrographs of the PLA/TiO_2 scaffolds prepared by FFF

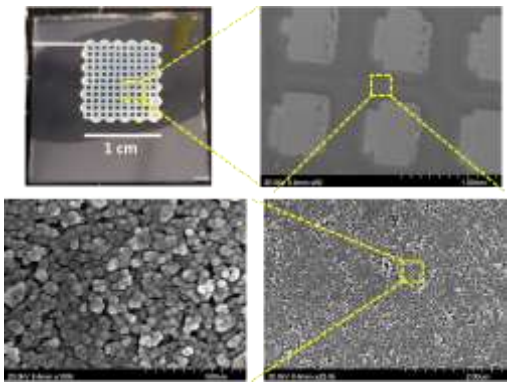

Figure 2: Picture and micrographs of the TiO_2 patterns prepared by IJP