Heterostructured Au/Ag-MoS_2-TiO_2 inverse opal photocatalysts

S. Loukopoulos*, S. Gardelis, V. likodimos
Section of Condensed Matter Physics, Department of Physics, National and Kapodistrian University of Athens, Athens, Greece

Z. Sideratou, F. Katsaros, E. Sakelis, A. G. Kontos
Institute of Nanoscience and Nanotechnology, National Center for Scientific Research "Demokritos", Athens, Greece

Heterostructured Au/Ag-MoS_2-TiO_2 inverse opal photonic films were fabricated using the evaporation induced co-assembly of polystyrene colloidal spheres with a hydrolysed Ti alkoxide precursor, MoS_2 nanosheet and Au/Ag nanoparticle suspensions, in order to enhance the photocatalytic activity of TiO_2 in the visible range, where titania is inactive because of its wide band gap [1]. Liquid cascade centrifugation was used in order to select MoS_2 nanosheets of smaller sizes [2], which were then loaded on the mixed precursor at variable amounts. SEM measurements showed that low concentrations of MoS_2 during synthesis preserve the integrity of the inverse opal structure (Figure 1). The incorporation of MoS_2 and Au/Ag nanoparticles in the nanocrystaline TiO_2 skeletal walls was investigated by TEM, EDX, and Raman measurements. Photoluminescence and electrochemical measurements were employed to evaluate charge transfer for MoS_2-TiO_2 in combination with plasmonic effects. Specular reflectance measurements showed that controlling the inverse opal diameter can fine-tune the photonic band gap position, allowing to combine photonic amplification with the optimal film composition that maximizes photocatalytic performance for salicylic acid degradation.

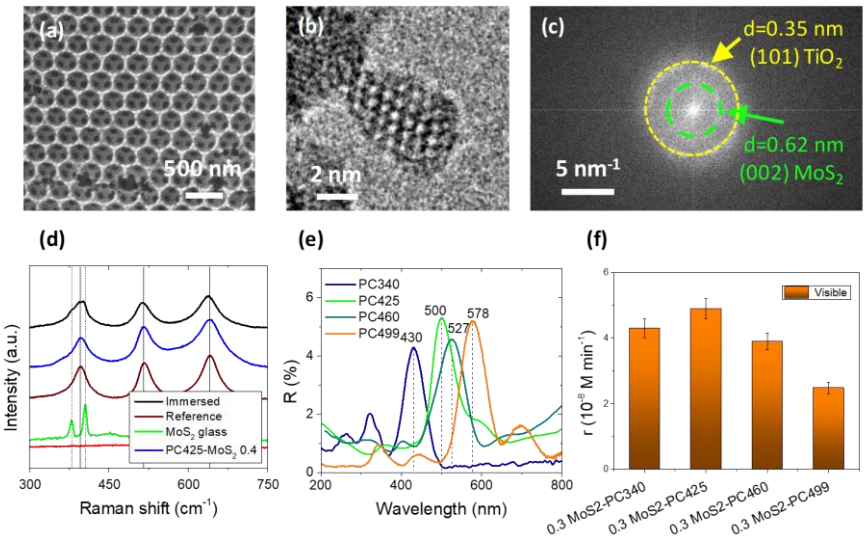

Figure 1: (a) SEM and (b) TEM images for PC425-MoS_2 inverse opals and (c) the corresponding FFT pattern. (d) Raman and (e) specular reflectance spectra of MoS_2-TiO_2 films. (f) Reaction rates of salicylic acid degradation under visible light.

Acknowledgements
The research work was supported by the Hellenic Foundation for Research and Innovation (H.F.R.I.) under the "First Call for H.F.R.I. Research Projects to support Faculty members and Researchers and the procurement of high-cost research equipment grant" (Project Number: 543).

References

[1] V. Likodimos, Appl. Catal. B Environ. **230**, 269 (2018).
[2] K. Synnatschke, P. A. Cieslik et al., Chem. Mater. **31**, 10049 (2019).

* sloukop@phys.uoa.gr