



Inverse opal photonic crystals as a strategy for the photooxidation of VOCs

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Volatile Organic Compounds (VOCs)

Paint solvent (automobile industry)



Automotive gas exhaust



Natural VOCs



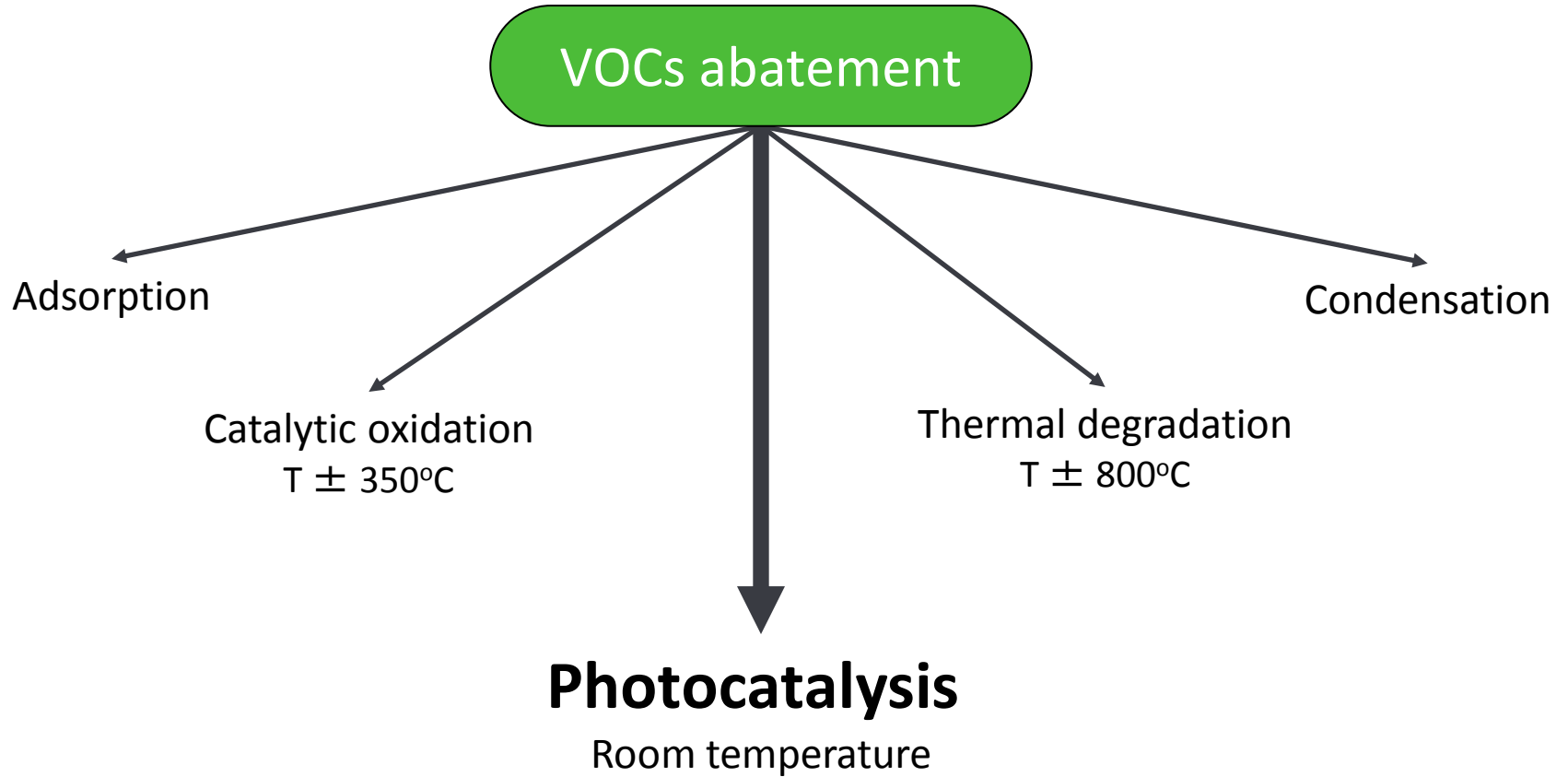
VOCs Hazard

Lung cancer



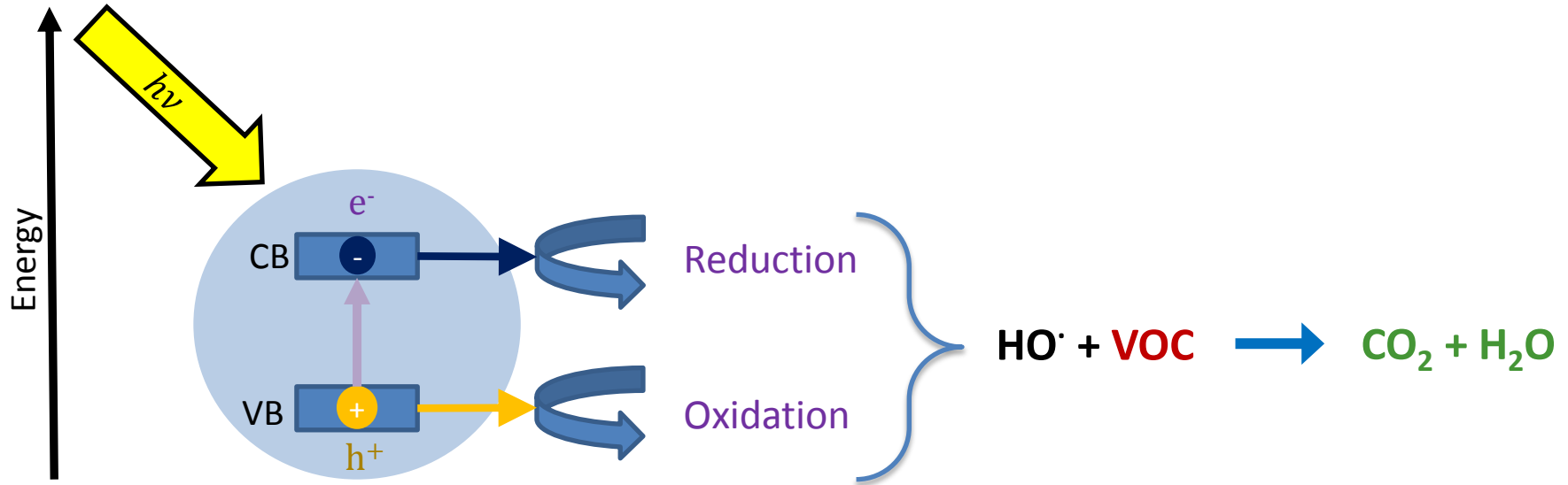
Increased ozone formation in the troposphere







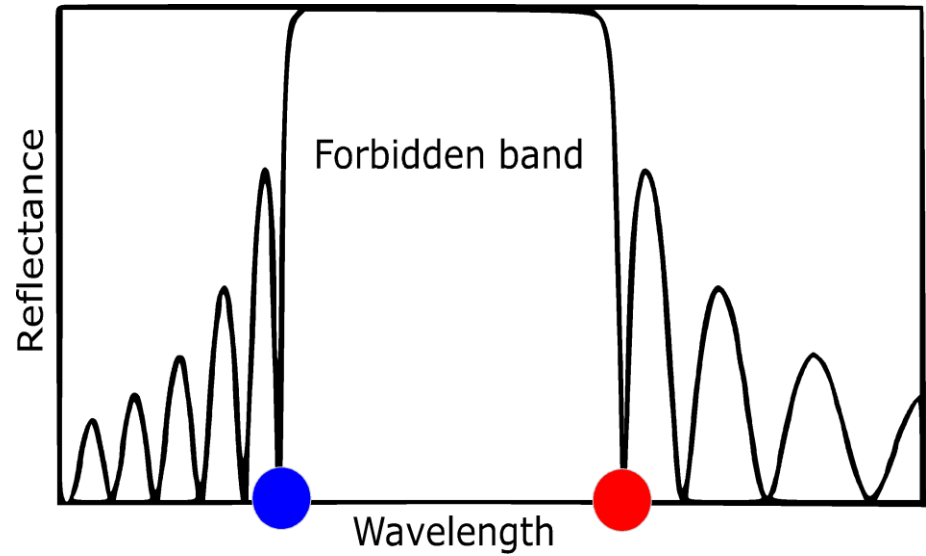
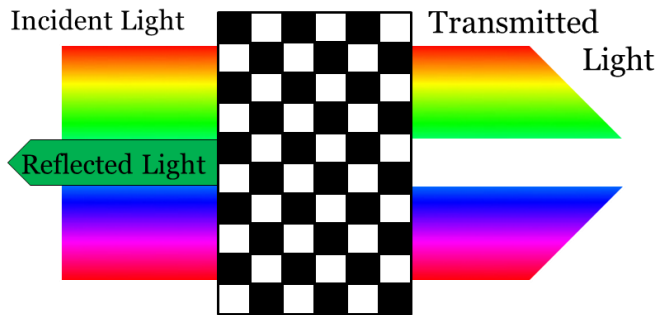
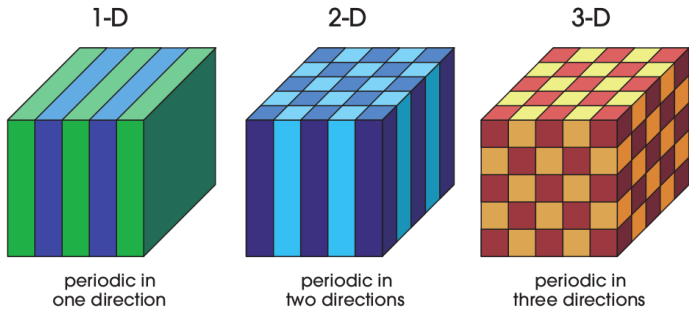
Photocatalysis



VOCs degradation proportional to absorbed light quantity



Photonic crystals



Blue- and red-edge



Increase
light
absorption

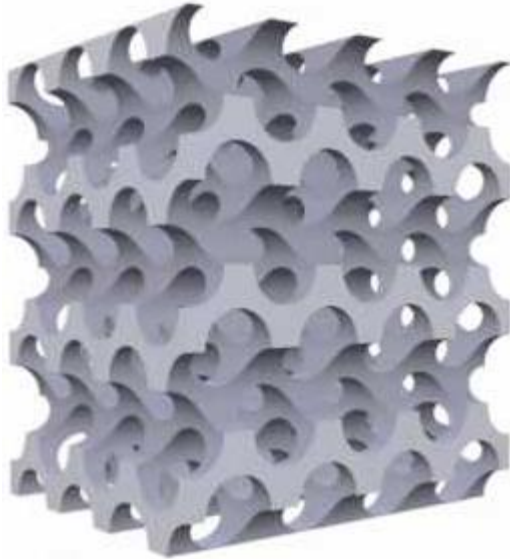


Increase
photocatalytic
activity



Photonic crystal

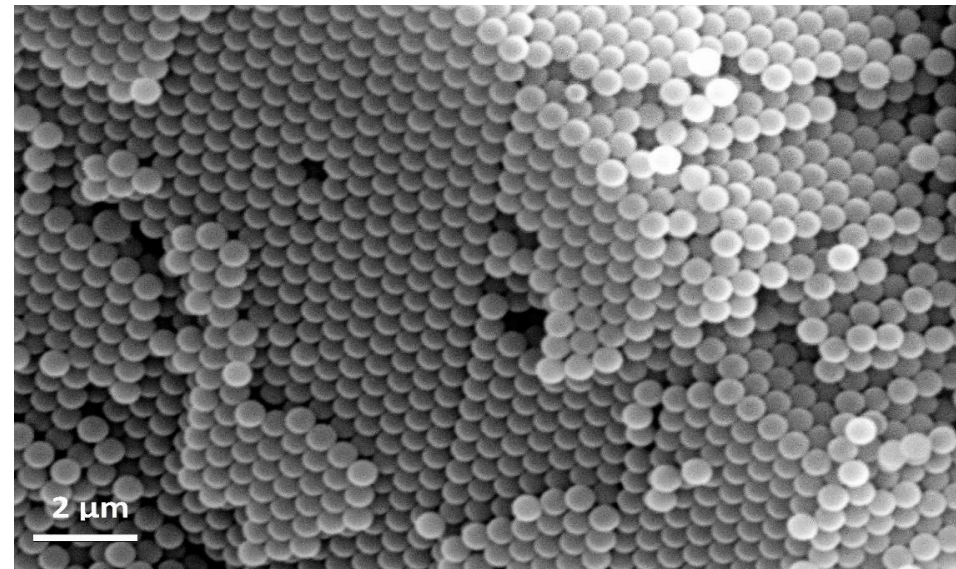
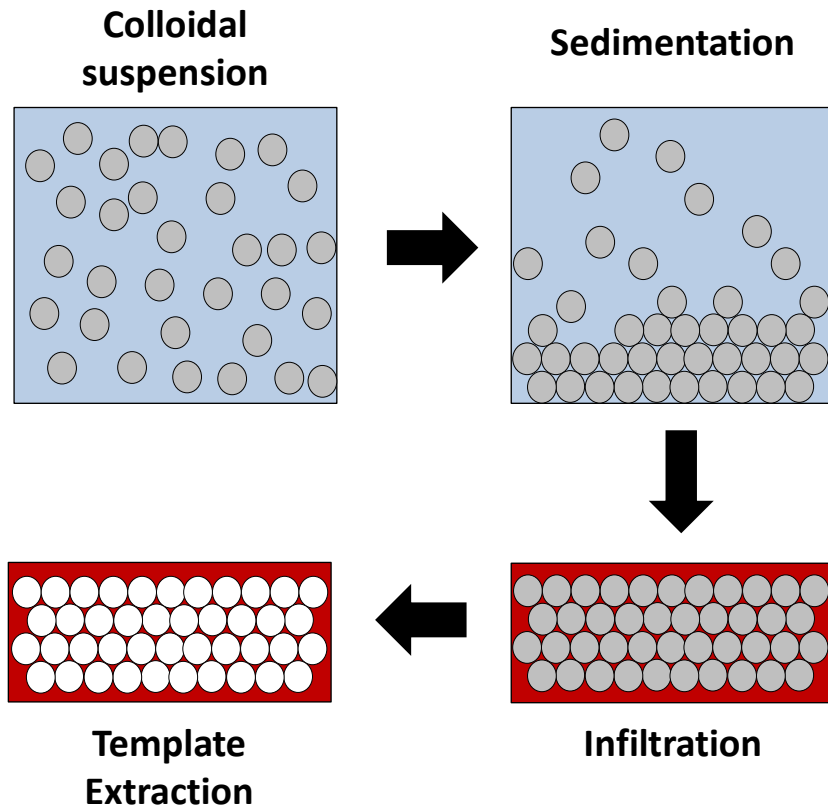
Inverse opal



- Pore size determined by diameter of template's beads
- Produced by the infiltration of the opal template
- Similar optical properties as the opal template



Synthetic opal structures

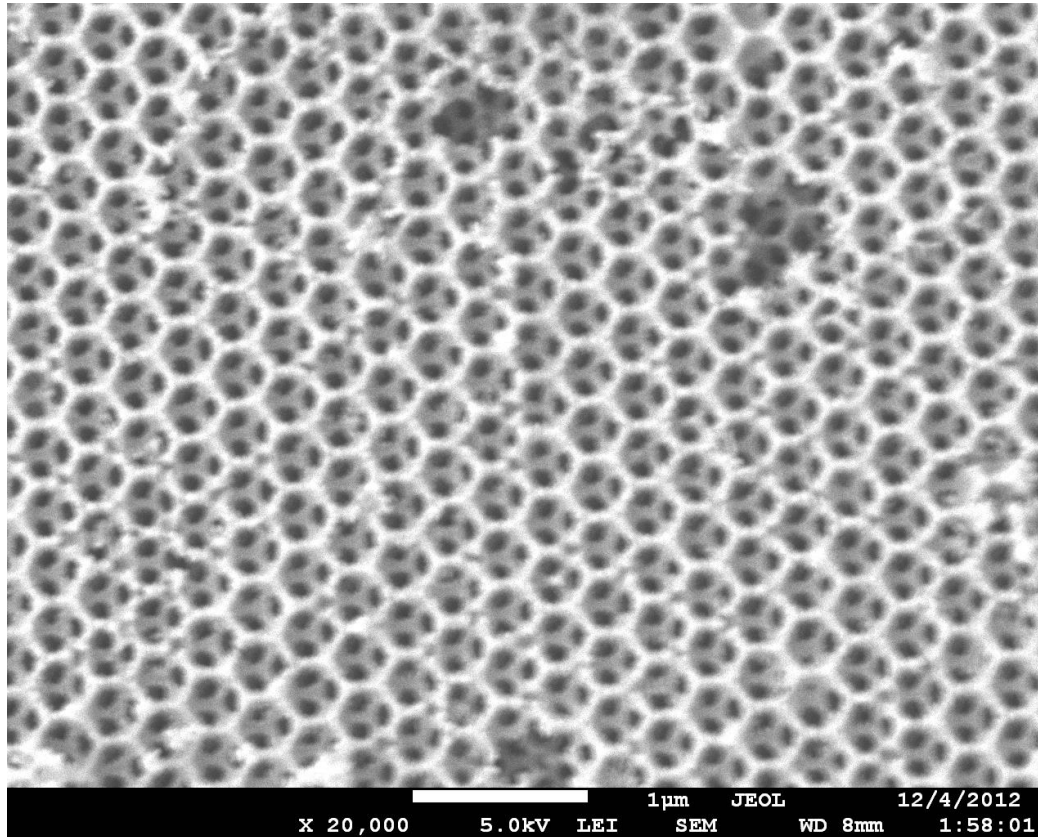


Zalfani et al. *J Mater Chem A* **2015**, p.21244

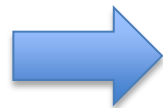
Shiraishi et al. *Angew Chem* **2010**, p.1700



TiO₂ Inverse opal



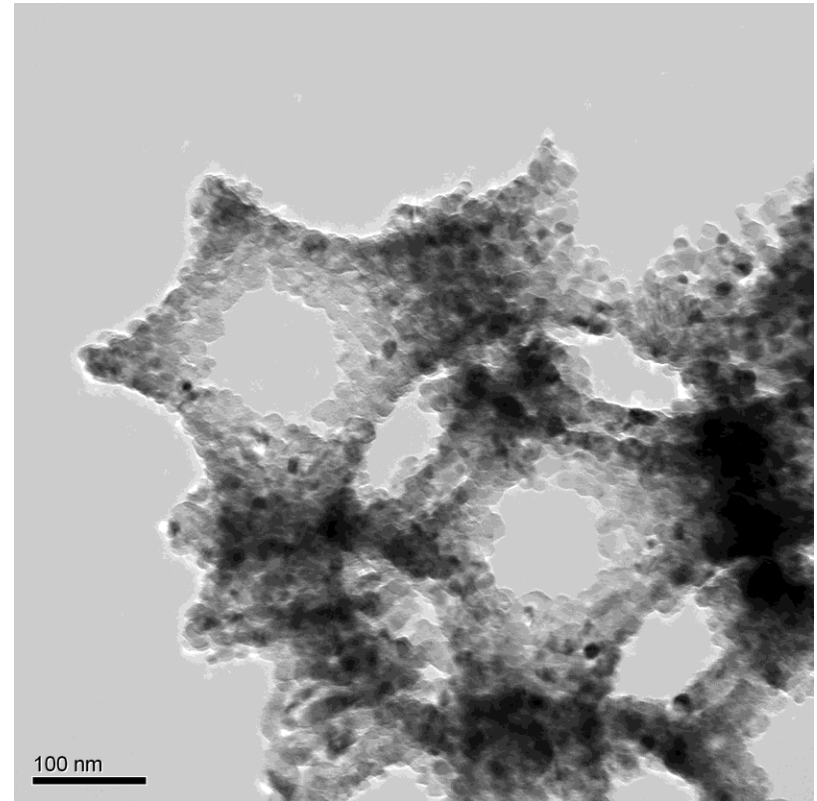
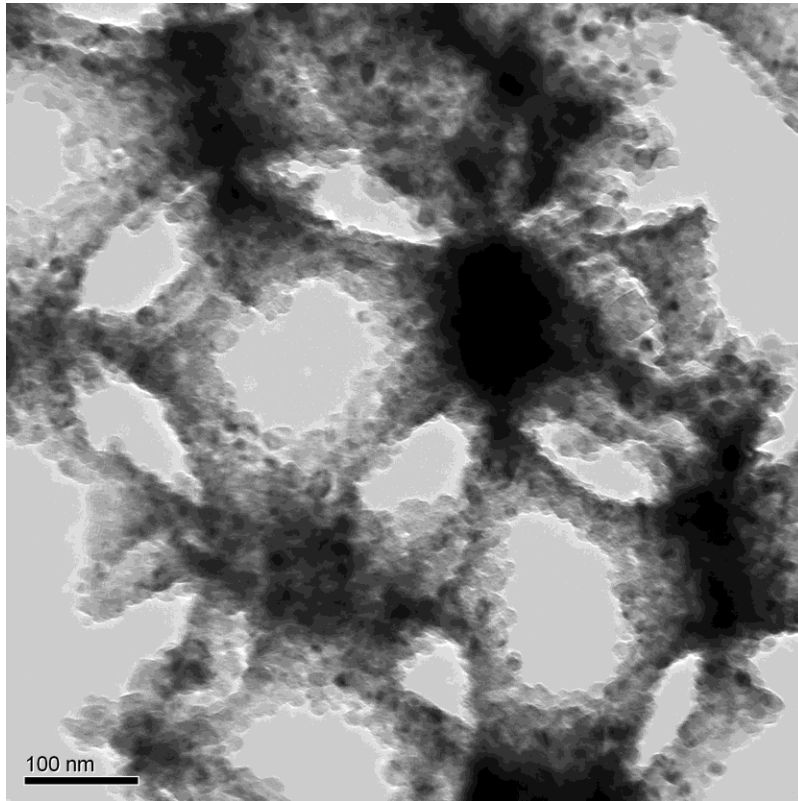
- Pore size: 350nm
- Dense wall



Three-dimensionally ordered macroporous (3DOM)



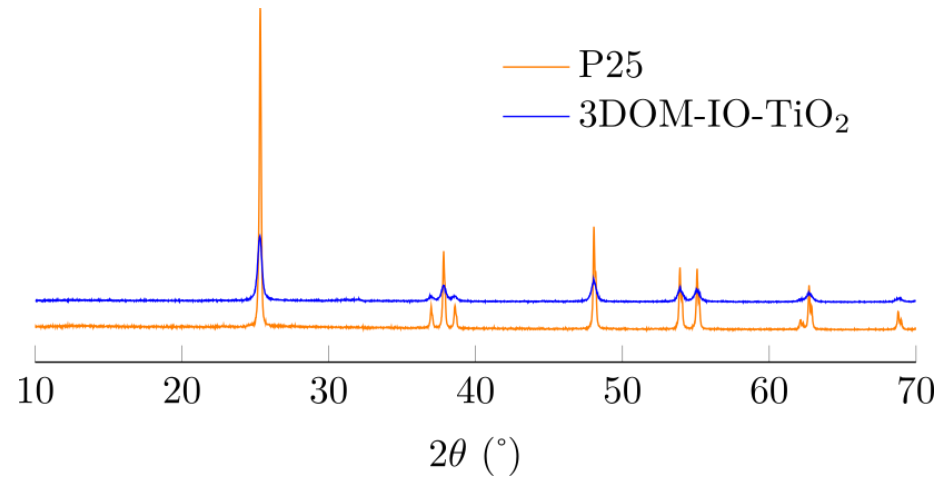
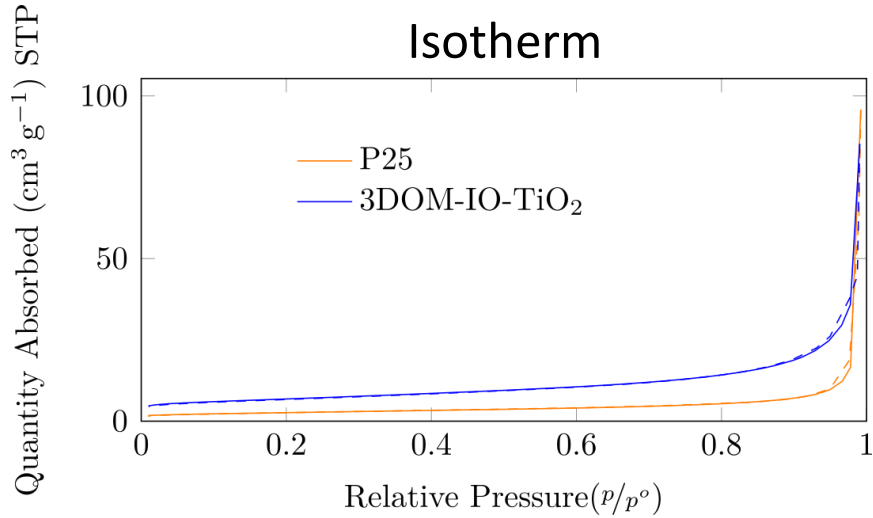
TiO₂ Inverse opal



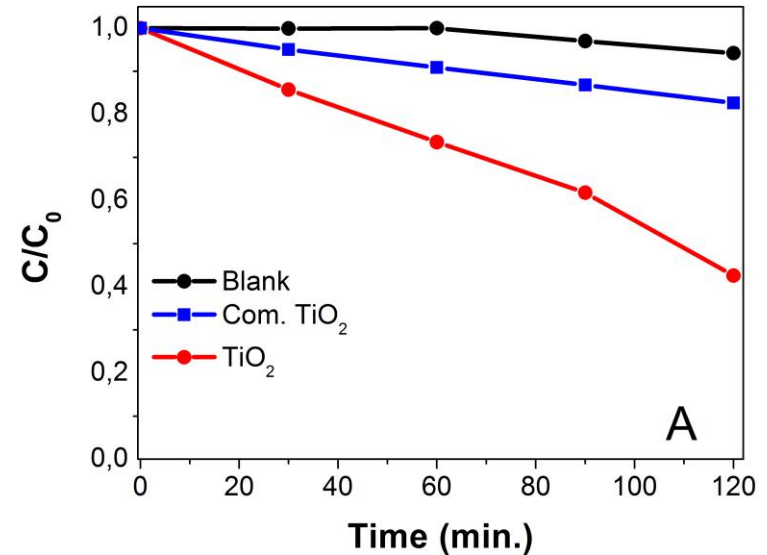
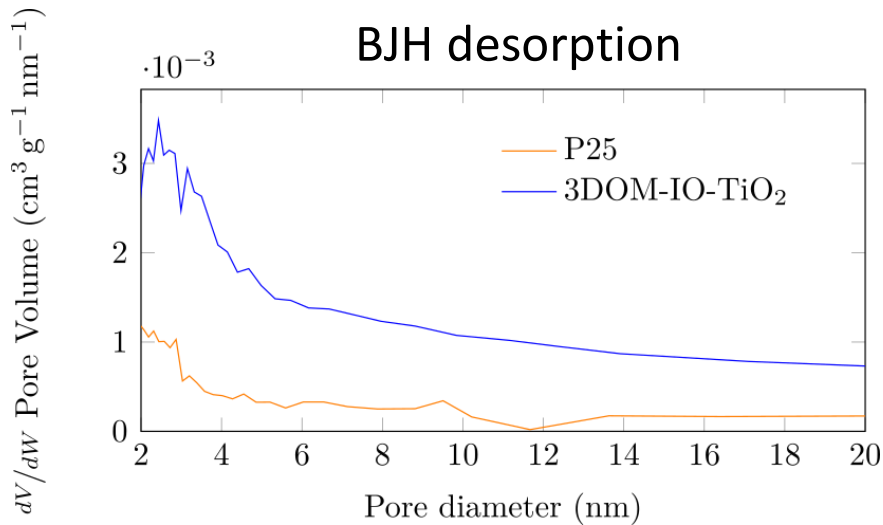


Textural properties

Isotherm



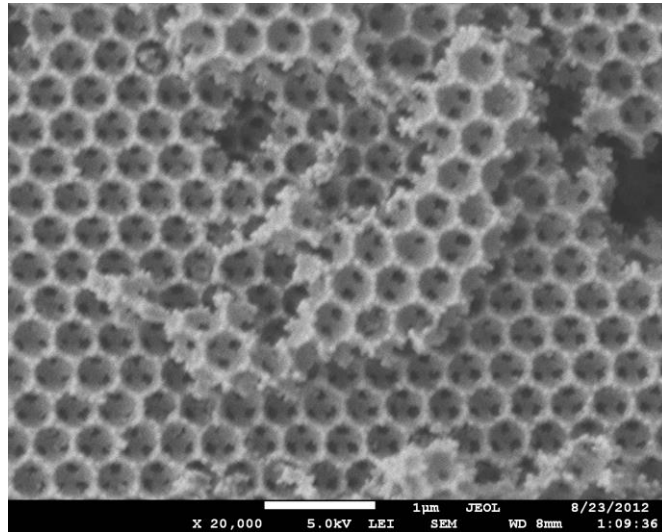
BJH desorption



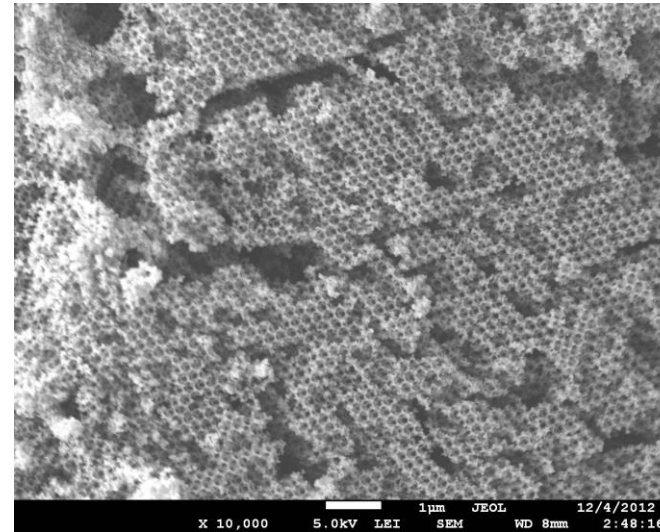


Doping of inverse opals

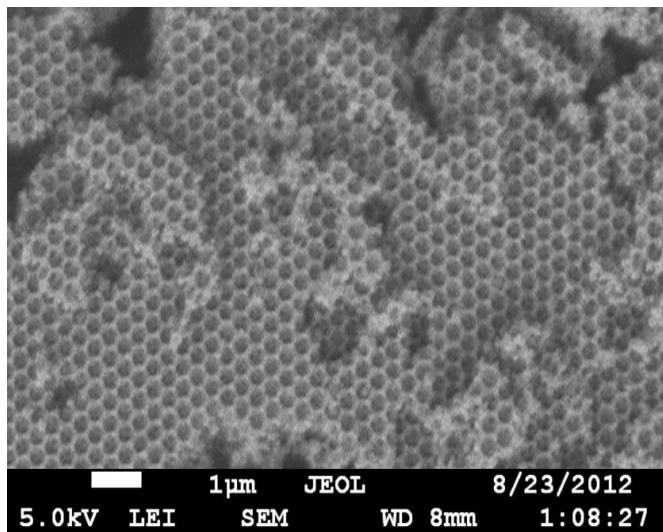
TiO₂ - N



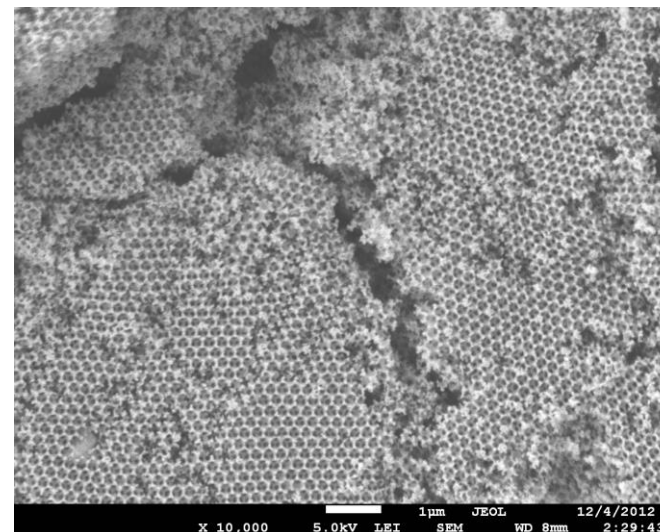
TiO₂ - Ta



TiO₂ - V

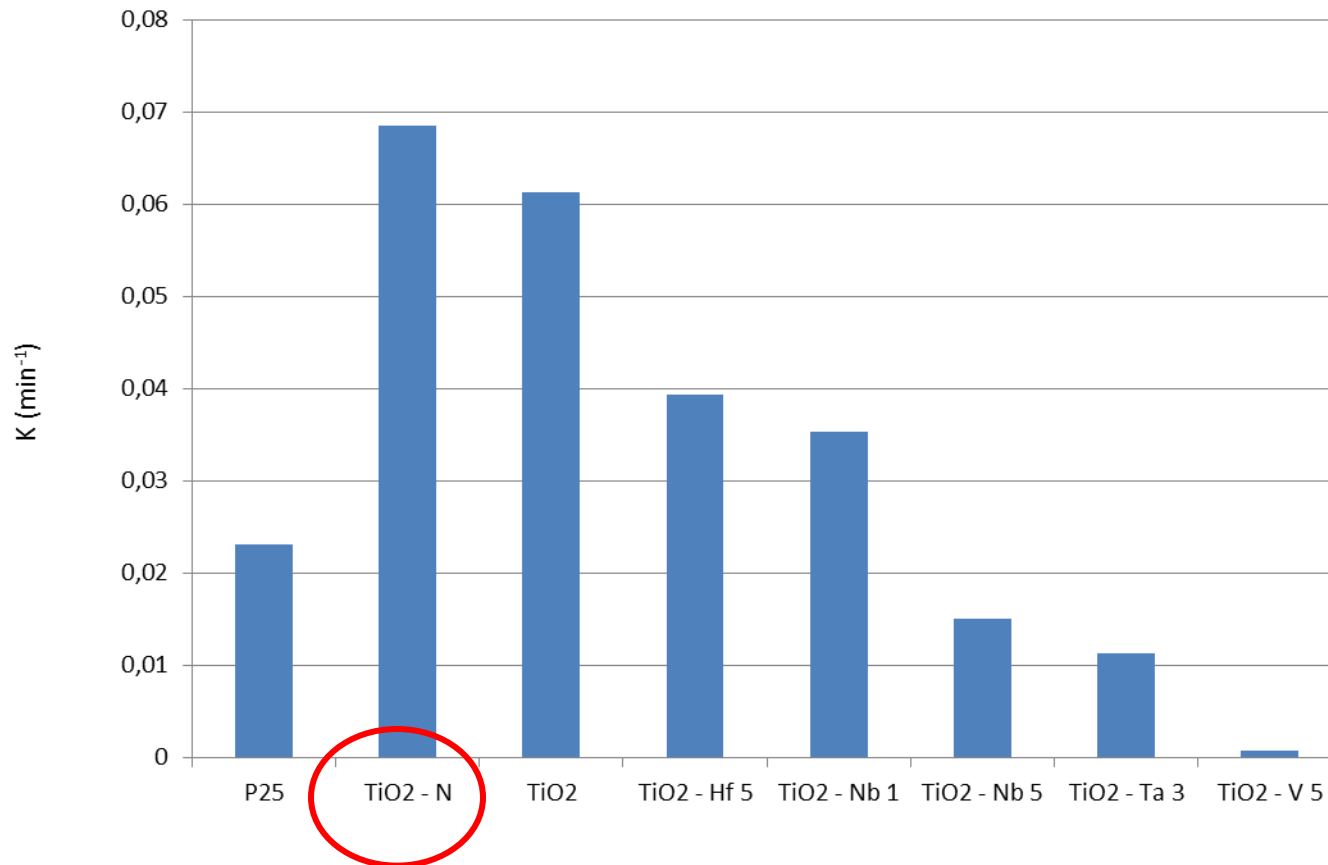


TiO₂ - Nb



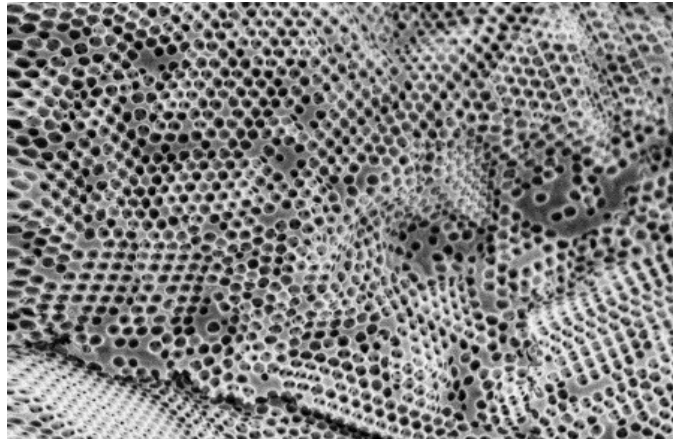


Photocatalytic degradation of Rhodamine B

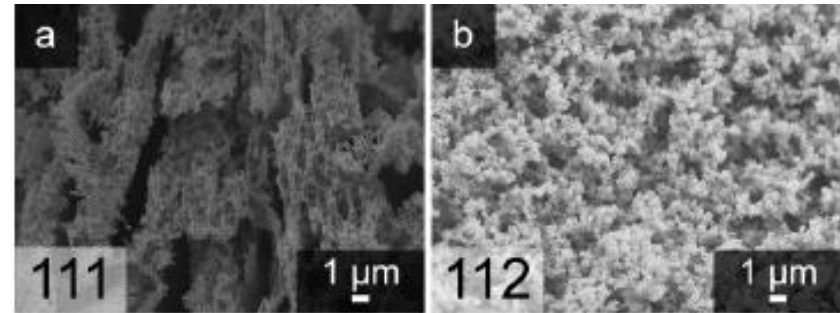




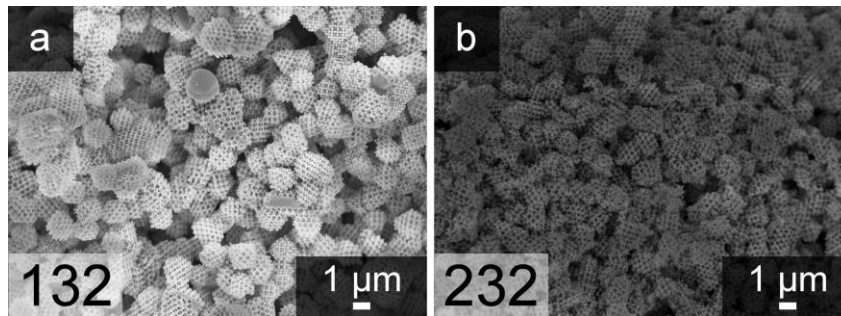
Varieties of inverse opals



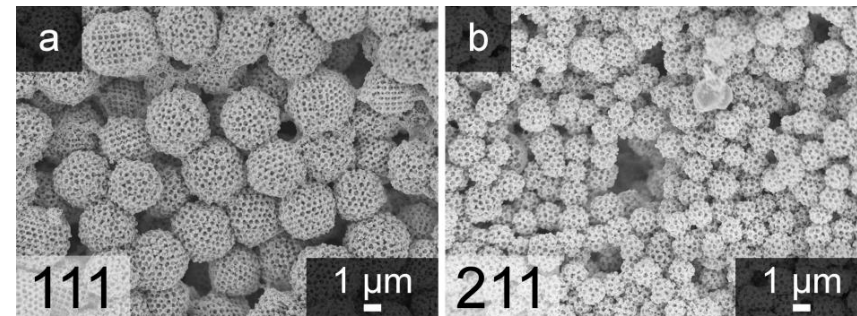
Ga_2O_3



Fe_2O_3



CeO_2

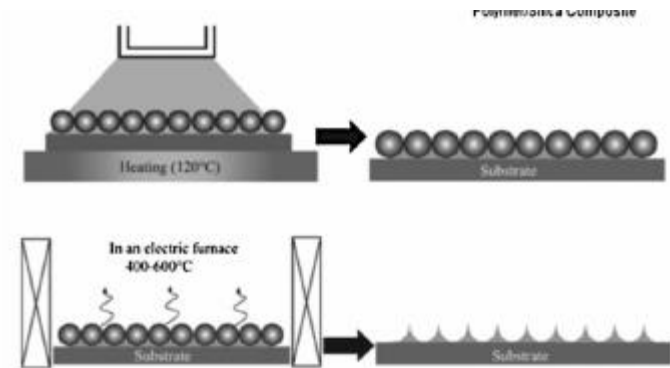
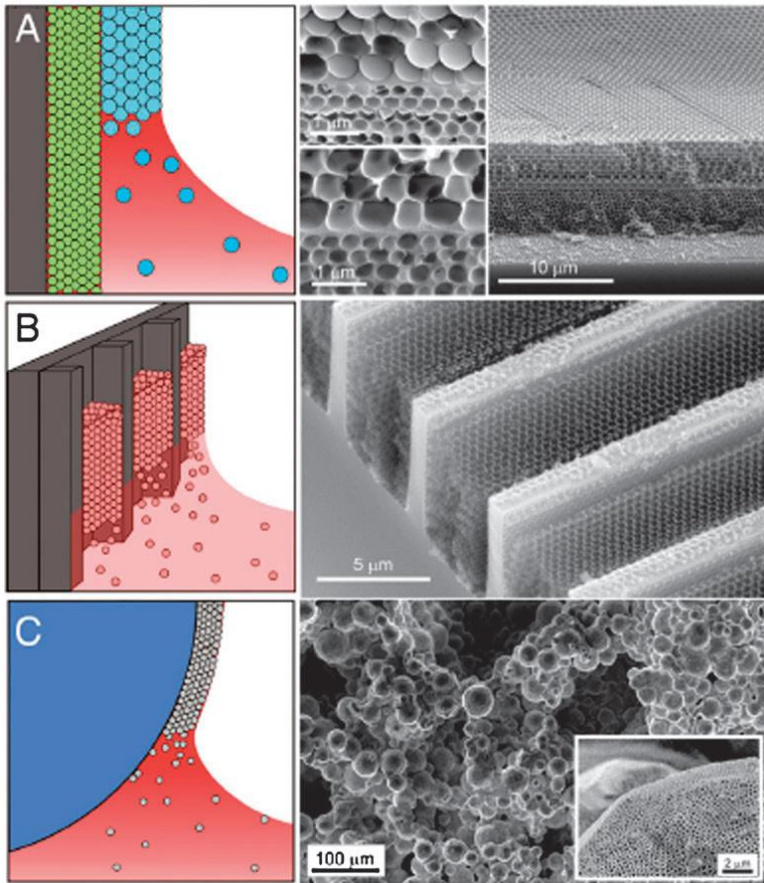


CeMgO

Rudisill et al. *Inorg. Chem.* **2015** p.993



Easy deposition on substrates



- Horizontal or vertical deposition
- Glass, ceramic and metallic substrates

Stein et al. *Chem. Soc. Rev.* **2013** p.2763



Summary

- Inverse opals provide highly porous structures
 - ➔ increased diffusion of pollutants
 - ➔ enhanced photocatalytic performances
- Doping or loading with nanocomposites increases the absorption interval
- Promising materials that can be used in photocatalytic processes



Thank you for your time

