Electronic Supporting information

Thermally stable SiO_2@TiO_2 core@shell nanoparticles for application in photocatalytic self-cleaning ceramic tiles

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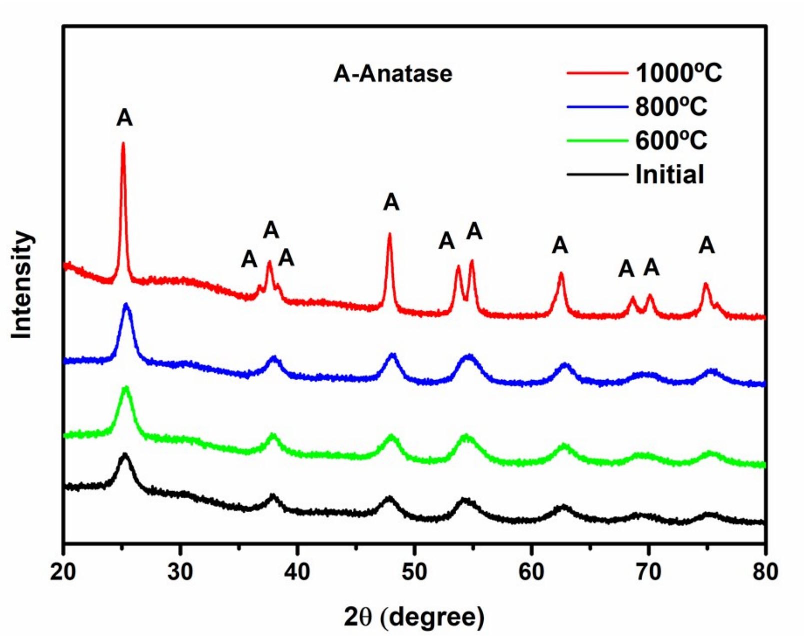

Figure S1 – *Ex-situ* Powder X-ray diffractograms of SiO_2@TiO_2 (annealed at 600 °C, 800 °C and 1000 °C for 1h) obtained using a benchmark Bruker D8-Advance X-ray diffractometer.

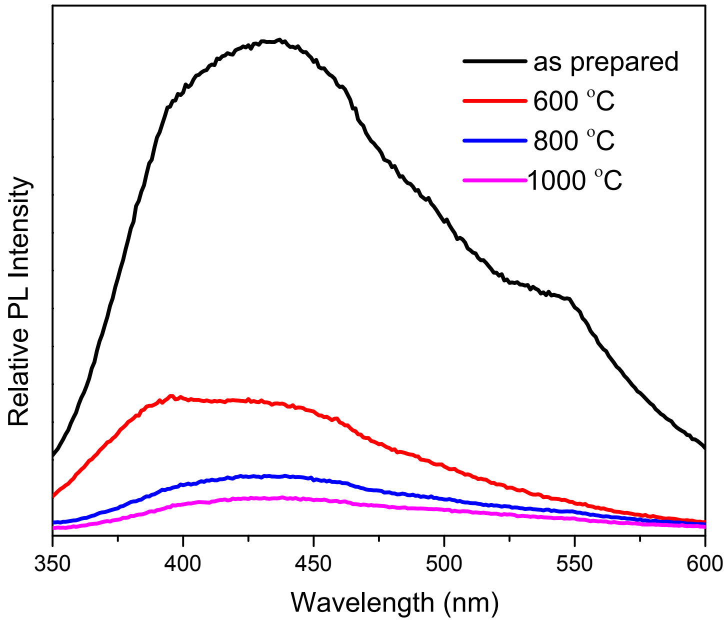

Figure S2: PL emission spectra under 325 nm of the $SiO_2@TiO_2$ particles beofre calciantion and after calcination at diffrent temparture.

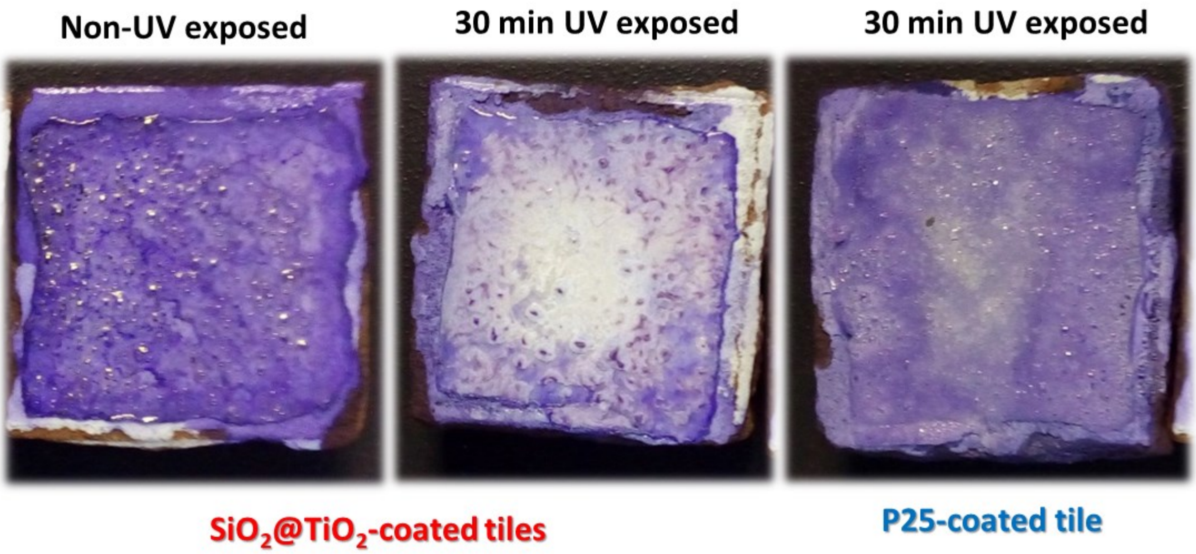

Figura S3. Digital photo of the CV-covered industrially-fired tiles after 30 min exposure to UV light. The $SiO_2@TiO_2$-coated tile exhbits better self-cleaning activity than P25-coated tile.

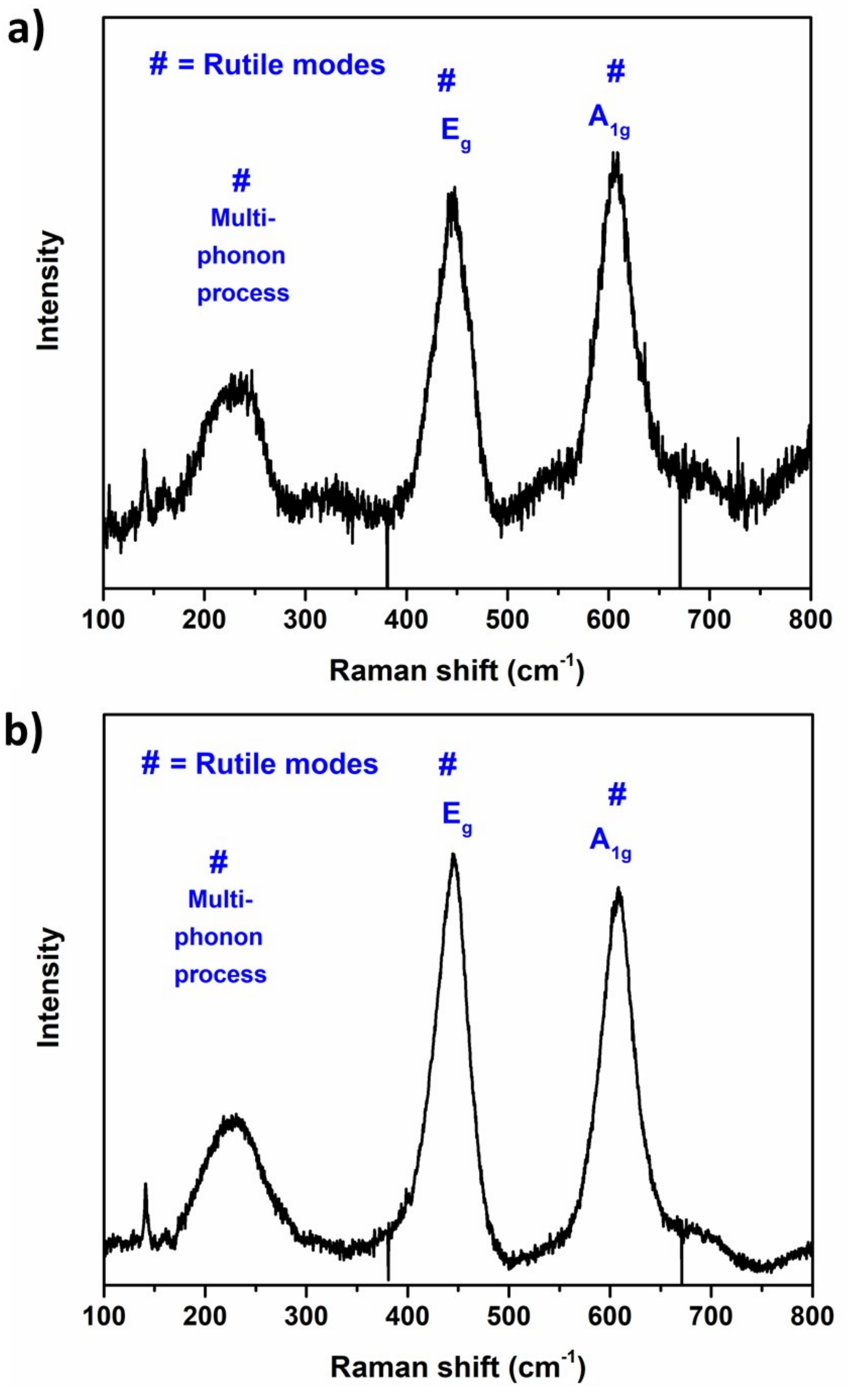

Figura S4 - Raman spectra of the P25 TiO_2–coated ceramic tiles after annealing using (a) laboratory furnace (1000 °C, 1h, 15°C/min) and (b) industrial single firing process(1140 °C, 20 min). The Raman modes of rutile have been marked (#) on the Raman spectra. The high-temperature firing leads to complete conversion of the anatase fraction of P-25 to rutile phase in both cases.

Table S1: Comparions of the preparation methods and photocatalytic performance of diffrent TiO_2-based coatings

Coating Material	**Tile type**	**Firing temperature**	**Final TiO_2 Crystalline phase**	**Photocatalytic behavior**	**Reference**
Micrometric anatase particles	Fired glazed ceramic tiles	600–1100 ºC (lab oven)	Anatase-rutile mixture (600 ºC); Rutile (1100 ºC	Good photoactivity for materials sintered at 600–950 ºC. No photoactivity for samples fired at 1100 ºC	[1]
Sub-micrometric anatase particles (dispersed in glaze mixture)	Fired glazed ceramic tiles	850–900 ºC (lab oven)	Rutile (resulting from A→R transformation at 850–1000 ºC)	Low photoactivity due to A→R transformation and entrapment of TiO_2 particles inside the glaze layer	[2]
TiO_2 anatase nanoparticles	Unfired and fired (glazed or unglazed) ceramic tiles	600–1000 ºC (lab oven) or 1210 ºC (industrial single firing)	Rutile (resulting from A→R transformation at 1000–1210 ºC	Good photoactivity for samples treated at 600 ºC. Negligible photoactivity for samples fired at 1000–1200 ºC due to A→R transformation and drastic increase in crystallite size	[3]
Nb_2O_5-doped TiO_2 nanoparticles	Fired glazed ceramic tiles	600–900 ºC (lab oven)	Anatase-rutile mixture (800 ºC); Rutile (900 ºC)	Better photoactivity than undoped TiO_2 coating which decreases upon calcination at 900 ºC	[4]
Nanocrystalline W-doped TiO_2 films	Fired glazed ceramic tiles	400–800 ºC (lab oven)	Anatase (800 ºC)	Highest photoactivity for samples treated at 600 ºC which decrease upon calcination at 800 ºC. W-doping prevented A→R transformation at 800ºC but did not improve photoactivity compared to undoped titania film	[5]
SiO_2@TiO_2 nanoparticles	Unfired glazed ceramic tiles	1000 ºC (lab oven) or 1140 ºC (industrial single firing procedure)	Anatase (1000 ºC); Partial conversion to rutile (1140 ºC)	Higher photoactivity than P25 (TiO_2) control samples. Highest photoactivity after single fire sintering (1140 ºC) due to formation of anatase/rutile heterojunction	This study