Immobilization of tungsten trioxide on the surface of mesoporous silica: structural investigation of the role of crystalline water on photocatalyst stability

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Tungstite ($WO_3.H_2O$), was successfully immobilized on the surface of mesoporous Silica **SiO_2/WO_3** by in-situ reaction using poly (ethylene oxide) as polymeric template and Na2WO4 as precursor and immobilized tungsten trioxide **SiO_2/WO_3-C** was obtained by calcination of **SiO_2/WO_3** at 350°C. The as-obtained materials were characterized by N_2 sorption, SEM, PXRD, FT-IR, UV-Visible and TGA.

Structural characterization of both materials indicates the succeed immobilization of tungstite and tungsten trioxide in amorphous silica. The diffraction picks in **SiO_2/WO_3** are arising from two different phases corresponding to WO_3 and $WO_3.H_2O$, Rietveld refinement assume the orthorhombic crystal lattice for both compounds to with parameters value a=5.25 Å, b=10.72 Å, c=5.13 Å for WO_3 and a=5.25 Å, b=10.72 Å, c=5.13 Å for $WO_3.H_2O$. phases quantification assumes the presence of tungstite ($WO_3.H_2O$) as a majority phase by 75.3%, which allow us to investigate it crystallographic structure. The crystal structure of the immobilized tungstite is generally formed by layers of distorted octahedral building blocks of WO_6 in which one axial oxygen position is occupied by water molecule. After calcination at 330°C a phase transformation to the monoclinic structure is observed and water molecules are eliminated from the structure, lattice parameters obtained after Rietveld refinement are a=7.32 Å, b=7.54 Å, c=3.85 Å.

The as-prepared materials are highly efficient in the oxidative photo-degradation of sulfamethazine in water with an efficiency of 92.14% and 92.84% for **SiO_2/WO_3** and **SiO_2/WO_3-C** respectively, with different stability aspect. Indeed, **SiO_2/WO_3-C** show a poor stability when it reused for 6 times due to leaching problem. In the other hand **SiO_2/WO_3** could be reused with a small loss of activity after 6 cycles of photocatalysis. The stability difference is due to crystallographic structure differences that is characterized by the presence of water molecules in **SiO_2/WO_3** and its absence on **SiO_2/WO_3-C.** The good stability can be attributed to the strong van-der-walls interaction between the oxygen of silica network and the hydrogen of water molecule encapsulated in tungstite structure.

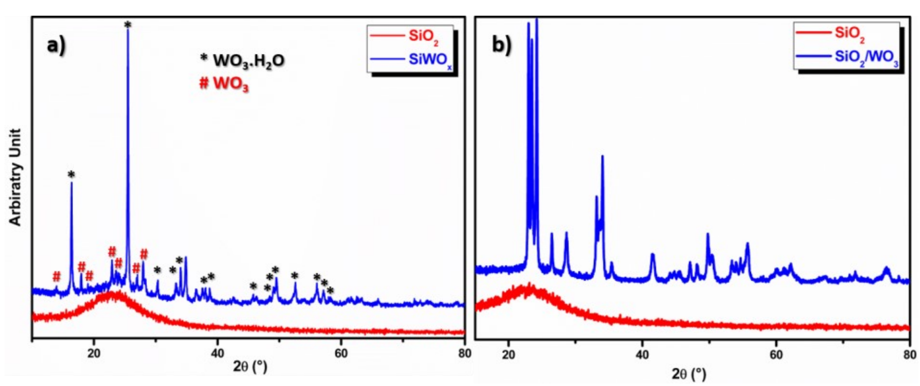

Figure 1: XRD pattern (a) SiO_2/WO_3 and (b) SiO_2/WO_3

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