

## Functionalization of mesoporous silica material (SBA-15-type) with polyether chains as a strategy for controlling antibiotic delivery

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### Abstract

Adsorption studies of tetracycline on the mesoporous silica SBA-15 functionalized with polyether chains (PE) in various proportions (ranging from 0.1 to 0.8 mol%) were performed. Thermogravimetric Analysis (TGA) showed influence of initial concentration of tetracycline on the loading. N<sub>2</sub> adsorption/desorption showed that pore volume (V<sub>p</sub>) and specific surface area (SSA) decrease after drug encapsulation.

*Key words: SBA-15, Tetracycline, Drug Delivery System*

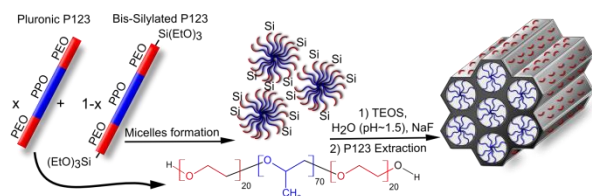
### Introduction

Mesoporous silica materials present high potential as drug carriers due to high pore volume and superficial area,<sup>1</sup> which can allow the adsorption of large amounts of drugs in the structures. Additionally, the surface functionalization of silica<sup>2</sup> permits the inclusion of moieties or ligands that can improve pharmacokinetic properties of solids and mediate selective interactions with cells and microorganisms<sup>3</sup>.

In this sense, our purpose is to produce a hybrid organic-inorganic material based on the silica SBA-15 functionalized with polyether chains<sup>4</sup> aiming at the delivery of antibiotics.

### Results and Discussion

The synthesis method (Image 1) is based on the polycondensation of TEOS and bis-silylated pluronic P123. One pure SBA-15 sample and 4 samples with (bis-silylated P123)/(bis-silylated P123+P123) ratio ranging from 0.1 to 0.8 mol % were prepared.

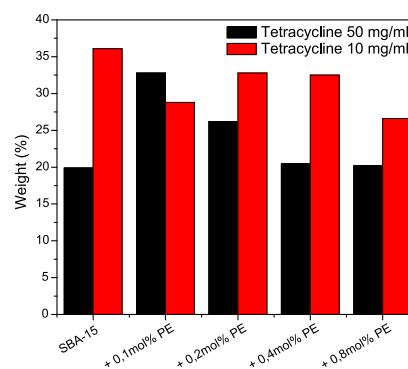


**Image 1.** Scheme of the synthesis of silica SBA-15-based materials.

N<sub>2</sub> Adsorption/Desorption (Chart 1) points out the influence of PE chains proportion in the surface area - SSA and pore volume - V<sub>p</sub>.

TGA analyses (Image 2) show that the amount of adsorbed drug increase when concentration is 10 mg/mL rather than 50 mg/mL. Following the material and the initial concentration of

tetracycline, drug loading is in the range of 20-35 wt%.



**Image 2.** TGA after tetracycline encapsulation (10 and 50 mg/mL) at ambient conditions for 24h.

**Chart 1.** N<sub>2</sub> Adsorption/Desorption. Before (Black) and after (red) drug encapsulation (50 mg/mL)

Tetracycline 50mg/mL	BET Surface Area SSA (m <sup>2</sup> g <sup>-1</sup> )	Pore Volume (cm <sup>3</sup> g <sup>-1</sup> )	Average Pore Width (nm)
SBA-15	750 / 370	1.3 / 0.7	7/7
0.1mol%PE	650 / 240	1.2 / 0.4	7/7
0.2 mol%PE	570 / 250	1.1 / 0.5	8/7
0.4 mol%PE	430 / 230	0.9 / 0.5	9/8
0.8 mol%PE	280 / 180	0.7 / 0.4	11/9

### Conclusions

An original synthesis method is proposed. The produced materials enable high SSA and high drug loading (20-35 wt%).

### Acknowledgement

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<sup>1</sup>Yang, P. The Chemistry of Nanomaterials, World Scientific, 2003;

<sup>2</sup>Li, Z. et. al. Chem Soc. Rev., 2012, 41, 2590-2605;

<sup>3</sup>Wittig, R. et. al. Nanomedicine, 2014, 9(7), 971-978;

<sup>4</sup>Grandsire, A. F. et. al. Appl. Organometal Chem, 2010, 24, 179-183.