

PhD in Chemical Engineering

Research Title: Synthesis of zinc oxide nanoparticle and study of their biodegradation behaviour

Funded by	DISAT with funding by European Research Council (ERC)
-----------	---

Supervisor	Prof. Valentina Cauda valentina.cauda@polito.it
------------	---

Contact	www.polito.it/TNHlab
---------	--

Context of the research activity	<p>One of the most important problems to be faced when considering the application of a nanodevice in medicine regards its potential toxicity and biocompatibility with living cells and tissues. Zinc Oxide (ZnO) nanomaterials are acquiring increasing interest in the biomedical field and still open questions remain about their safety or potential toxicity, as well as on their potential biodegradation behavior. ZnO has revealed toxic actions preferentially toward cancer cells, which could serve as a foundation for developing new cancer therapeutics. In particular, the different dissolution and toxicity behaviors to living cell systems have a strong dependence on the size, shape and synthetic routes of the ZnO nanostructure. Moreover, the surface modification of ZnO can be crucial for its biomedical application. ZnO is indeed very rich of hydroxyl groups on the surface, thus enabling a versatile and facile conjugation with various biocompatible polymers, lipids, imaging labels, and drugs, among others. Actually, recent efforts in nanomaterial design as injectable biomedical tools have addressed the need of guarantee adequate circulation times and prevent thrombogenic effects by covering them with stealth polymers.</p> <p>It is therefore of great scientific interest to study the colloidal stability, degradation and possible toxicity pathways of ZnO nanomaterials as a function of various synthetic and morphological parameters in simulated and biological fluids.</p>
----------------------------------	---

Objectives	<p>The research activity aims at synthesizing zinc oxide nanostructures, mainly round-shaped and having up to 100 nm in diameter, functionalize with stealth polymers or lipids, and characterize them in terms of biodegradation and safety in simulated and biological fluids, as well as with living cancer cells.</p> <p>The main aims of this PhD are thus to:</p> <ol style="list-style-type: none"> 1) Synthesize and characterize ZnO nanoparticles by wet-chemical routes 2) Functionalize their surface with chemical anchoring groups and eventually polymers, lipids or capping agents for improving colloidal dispersion 3) Set up protocols for the biodegradation and safety assessments of the nanoparticles in simulated and biological media; 4) Study the dissolution/biodegradation behaviour of the nanoparticles and obtained by-products facing with conventional physico-chemical techniques
-------------------	--

Skills and competencies for the development of the activity	<p>The candidate should have a Master Degree in Chemical Engineering.</p> <p>He/she will perform the synthesis, functionalization, and biodegradation assessments, thus the following competencies are required:</p> <ul style="list-style-type: none"> - Experience in chemical lab and in particular with wet-chemical synthetic approaches; - Chemical functionalization protocols; - Assembly protocols between nanoparticles and polymers or lipid structures - Working skills with common characterization techniques including X-Ray Diffractometry, Dynamic Light Scattering, Infrared and UV-Vis spectroscopy, Fluorescence Microscopy; - Sample preparation for transmission electron microscopy (TEM) and scanning electron microscopy.
--	---