PhD in Ingegneria Chimica

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

Funded by	MIUR – Dipartimento di Eccellenza

Supervisor	Ptrof. Davide Fissore, Prof. Valentina Cauda

Contact	davide.fissore@polito.it

Context of the research activity	The proposed PhD research is inserted in the context of the Excellence Research Project of the Department of Applied Science and Technology (DISAT), which aims to create a multipurpose facility with ionic, electronic, optical and force microscopies to characterize nanomaterials, expanding the already present instrumentations. The strategy of this Excellence research approach to the DISAT is also to enroll the best candidates for PhD programs, together with excellent and experienced Technicians, Researches and Professors. Within DISAT, several research groups face with nanomaterials and nanostructures preparation with various wet-chemical and dry-physical approaches. The characterization of such nanomaterials is essential to understand their properties and behaviors in diverse applications and this is mainly afforded by the above-mentioned microscopic facilities. Focusing on biomedical application, it is fundamental to understand the role of synthetic processes and surface functionalities in affecting the biological behavior of living systems, in particular when therapeutic and diagnostic nanotools have to be developed against the most common diseases, one in particular is cancer. It is therefore of great scientific interest to study the colloidal stability, therapeutic approaches, bio-imaging capabilities, and possible toxicity pathways of nanomaterials as a function of various synthetic and morphological parameters in simulated and biological environment, comprising also living cancer cells, to be studied taking chance of the microscopy excellence facility under development at DISAT.

Objectives	The research activity aims at prepare nanosized particles, by varying the processing parameters to deeply understand the connection to the synthetic and functionalization conditions to their properties towards biomedical applications. The further aims are then to develop therapeutic and/or diagnostic capabilities of such nanoparticles, and characterize them in biological fluids, as well as with living cancer cells. The main aims of this PhD are thus to: 1) Synthesize nanoparticles by wet-chemical routes; 2) Functionalize their surface with chemical anchoring groups and polymers, lipids or capping agents for improving colloidal dispersion; 3) Characterize them with a particular focus on electron microscopy facilities; 4) Set up protocols for nanoparticles safety assessments and therapeutic capabilities biological media, particularly in living cancer cells; 5) Characterize the therapeutic and eventual bio-imaging potential (i.e. photoluminescence emission) with a particular focus on fluorescence microscopy facilities for live cell imaging.

Skills and competencies for the development of the activity	The candidate should have a Master Degree in Chemical Engineering. He/she will perform the synthesis, functionalization, physico-chemical characterization of the prepared nanomaterials, in particular with microscopy facilities (electron microscopy and fluorescence optical microscopy, spectroscopic techniques) and test their therapeutic activity in living cancer cells. The following competencies are required: - Experience in chemical lab and in particular with wet-chemical synthetic approaches; - Chemical functionalization protocols; - Working skills with common characterization techniques including Infrared and UV-Vis spectroscopy, Fluorescence Microscopy, X-Ray Diffractometry, Dynamic Light Scattering; - Sample preparation for transmission electron microscopy (TEM) and scanning electron microscopy (SEM); - Good English knowledge.