PhD Program in Science & Technologies of Chemistry & Materials

Curriculum Nanochemistry

PhD in IIT "Polymers and Biomaterials" group - https://polbiom.iit.it/

Title: Proprietà anti-infiammatorie e anti-fibrotiche di nanomateriali polimerici organici a base di zolfo(II)" (Anti-inflammatory and anti-fibrotic activity of novel organic materials based on Sulfur (II)-containing polymers

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Description: Sulfur (II) organic polymers (polysulfides, polythioacetals) can effectively scavenge biologically relevant oxidants (Reactive Oxygen Species, ROS) such as hydrogen peroxide or superoxide. Since ROS typically act as inflammatory mediators (both intra- and inter-cellularly), their removal has important anti-inflammatory [1,2] and anti-fibrotic [3] consequences. Further, ROS-scavenging polymers may also fulfil a protective (sacrificial) role for sensitive molecules such as therapeutic proteins, being oxidized in their stead [4].

This project aims to utilize two classes of ROS-scavenging materials: surface-functional hydrophobic nanoparticles made of poly(propylene sulfide) and hydrophilic polymers based on poly(thioglycidyl glycerol). These two classes of materials will be employed in anti-inflammatory scenarios, specifically targeting the management of innate inflammatory activation.

The skills developed in the project will include monomer/polymer synthesis (including microfluidic-assisted scaled-up processes), nanomaterial/colloidal characterization, 2D/3D culture and molecular biology characterization of mammalian cell lines. Previous experiences in cell culture, materials characterization or polymer synthesis are strongly preferred.

References

[1] F. El Mohtadi et al., "A 'tandem' nanomedicine approach against osteoclastogenesis. Polysulfide micelles synergically scavenge ROS and release rapamycin", Biomacromolecules, 21 (2020) 305-318. DOI: 10.1021/acs.biomac.9b01348.

[2] Z.Y. Turhan et al., "Dual thermal- and oxidation-responsive polymers synthesized by a sequential ROP-to-RAFT procedure inherently temper neuroinflammation" Biomacromolecules, 24 (2023), in press. DOI: 10.1021/acs.biomac.2c01365.

[3]. A. Siani et al. "Polysulfide nanoparticles inhibit fibroblast-to-myofibroblast transition via extracellular ROS scavenging and have potential anti-fibrotic properties", Biomaterials Advances, 153 (2023) 213537. DOI: 10.1016/j.bioadv.2023.213537.

[4] R. d'Arcy et al., "A Reactive Oxygen Species-scavenging 'stealth' polymer, poly(thioglycidyl glycerol), outperforms poly(ethylene glycol) in protein conjugates and nanocarriers and enhances protein stability to environmental and biological stressors" Journal of the American Chemical Society, 144 (2022), 21304–21317. DOI: 10.1021/jacs.2c09232.

We are looking for highly motivated candidates with a degree in Physics, Chemistry, Material Science, Engineering or Nanotechnology that are keen to work in an interdisciplinary environment.