

**Doctoral School of Information and Biomedical Technologies
Polish Academy of Sciences (TIB PAN Doctoral School)**

SUBJECT: Multifunctional Nanomaterials for Local Cancer Therapy

SUPERVISOR: Prof. dr hab. Michael Giersig

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DESCRIPTION: This PhD project will focus on the design and synthesis of multifunctional magnetic nanomaterials engineered for targeted drug delivery, magnetic hyperthermia, magnetic resonance imaging, and photoactivity for photodynamic therapy, providing a synergistic approach to effective and localized cancer treatment. The research will involve the development of core-shell and hybrid nanostructures, combining magnetic cores with photosensitizing shells or surface ligands to enable light-triggered reactive oxygen species generation under near-infrared irradiation. Drug molecules will be loaded onto or within the nanocarriers, and controlled release will be evaluated under external stimuli, including alternating magnetic fields and light exposure, to maximize therapeutic efficacy while minimizing cytotoxicity to the health tissues. Advanced microscopic and spectroscopic characterization techniques will be employed to correlate structural and magnetic properties with therapeutic performance. The project will further involve *in vitro* evaluation using cancer cell lines to determine the cells viability, cellular uptake, photodynamic activity, and hyperthermia efficiency for further real-time monitoring of nanoparticle distribution and accumulation. The ultimate goal of this PhD project is to develop a multifunctional, biocompatible nanoplatform that enables simultaneous imaging and multimodal therapy, combining drug delivery, magnetic hyperthermia, magnetic resonance imaging, and photodynamic therapy within a single system, thereby contributing to the advancement of precision and effective cancer treatment strategies. This project will equip the PhD candidate with advanced skills in nanomaterials synthesis, surface modification, interdisciplinary biomedical application testing, and the translation of materials science into practical therapeutic tools, fostering readiness for both academic and translational research environments.

Requirements:

- MSc degree in Materials Engineering, Chemistry, Nanotechnology, Biomedical Engineering, or related fields.
- Strong background in fabrication of nanomaterials with wet-chemistry methods
- Experience in the characterization of nanomaterials with spectroscopic techniques
- Ability to conduct independent research as well as team work and interdisciplinarity
- Experience in scientific writing and communication in English