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Gabriela Gąsior

# DOCTORAL DISSERTATION ABSTRACT

Title of the doctoral dissertation:

**Biodegradable iron-based materials: the impact of the porous architecture and stability of the corrosion products layer on the degradation process and biological response**

Doctoral dissertation abstract: This doctoral dissertation investigates the synthesis and structural, morphological, and biological characterization of porous iron scaffolds, as well as the influence of porous architecture and corrosion product layers on degradation kinetics in aqueous environments. The primary objective was to determine whether controlling material architecture and surface properties can provide a more effective strategy for regulating degradation than traditional approaches based solely on modifying chemical composition. Based on the literature analysis, an original conceptual framework is proposed, describing the degradation of porous iron structures as a dynamic process occurring across multiple time regimes and governed by the interplay of structural, chemical, and transport factors.

The experimental section comprises the fabrication of porous iron scaffolds using polymer templates, followed by structural and surface characterization and degradation studies under static and dynamic conditions. Microscopic and diffraction techniques were employed to analyze microstructure and corrosion products, electrochemical methods were used to assess corrosion behavior, and changes in environmental pH were monitored. These investigations were complemented by *in vitro* biological tests to evaluate the basic biological effects of the observed degradation processes.

The results demonstrate that porous architecture significantly affects iron degradation by modifying local mass transport conditions and the stability of corrosion product layers, leading to distinct kinetic regimes over time. Classical electrochemical parameters do not consistently reflect the actual degradation rate of porous iron structures and require interpretation in conjunction with structural and chemical changes at the material surface. Biological studies confirmed the absence of undesirable cytotoxic effects under the investigated conditions. Overall, regulating material architecture and controlling the formation and stability of corrosion product layers are shown to be effective strategies for directing the degradation of porous iron structures, complementing or potentially surpassing traditional approaches based solely on chemical composition.