Empa, Swiss Federal Laboratories for Materials Science and Technology Laboratory for Joining Technologies & Corrosion

Empa
Materials Science and Technology

Master project or thesis

Tough but weak: understanding biocorrosion susceptibility of carbide-containing implants

What is this project about ? Implant materials fail due to unexpected corrosion upon their implantation in the complex physiological environment of the human body, with detrimental implications to patient health and safety. Key to the development of improved implant materials is an in-depth understanding of the link between material microstructure, surface oxide state, and surface reactivity. In this project, we will investigate clinically relevant cobalt-chromium-molybdenum (CCM) alloys used in dental and orthopedic applications for their high load-bearing ability. In these alloys, nano- to micrometer-sized carbides reside (see right image). Their benefit for the mechanical performance is without doubt, however the role of carbides in the local and macroscopic biocorrosion susceptibility of CCM alloys is still unclear.

Fig. 1: left: X-ray showing a total-hip replacement, one of the clinical use cases of Co-Cr-Mo alloys; right: SEM image of the alloy with marked carbides contained in the microstructure (red arrows)

The project will be conducted in the Laboratory of Joining Technologies and Corrosion at Empa Dübendorf. In this master thesis, you will (1) systematically study the biocorrosion behavior of permanent implant materials under clinically relevant conditions using an in-house developed dynamic setups, and (2) correlate the macroscopic electrochemical response with a detailed local analysis of surface characteristics (incl. local surface composition and reactivity assessment). The thesis involves: (a) electrochemical analysis, (b) microstructural investigations, and (c) surface characterization (SEM, XPS).

Who are YOU? You have a background in materials science, electrochemistry, corrosion or related, and are interested to zoom-in to today's implants to discover how they react upon implantation.

Who are WE? We are a young team investigating corrosion phenomena at the nano- to macroscale. We are enthusiastic about implant materials and their solid-liquid interface with physiological environments, driven to understand how biological matter modulates biomaterials surface reactivity, durability & function.

Contact for interest or questions:

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