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Glucose-Gated Polyetheretherketone Implants for Enzymatic Gas Therapy to Boost Infectious Diabetic Osseointegration

Abstract:

The hyperglycemic micromilieu surrounding implants in diabetic patients leads to high failure rate of implantation and implant-associated infection. Carbon monoxide (CO) has been reported to combat infections; however, its on-demand liberation and the elucidation of the underlying antibacterial mechanism remain challenging. To address this issue, we develop a multipurpose orthopedic implant comprising polyetheretherketone, glucose oxidase (GOx), and manganese carbonyl (MnCO), serving as a glucose-gated enzymatic gas therapy for infectious diabetic osseointegration. The GOx acts as a glucose-actuated gate responsive to hyperglycemia, thereby delivering CO in situ triggered by the GOx-driven Fenton-like reaction of MnCO. The released CO considerably prevents bacterial multiplication by penetrating the membrane, binding to cytochrome bo3, and interfering with the respiratory chain in vitro. Furthermore, the engineered implant displays desired antibacterial properties and enhances osseointegration in vivo. Collectively, the orthopedic implant is capable of delivering glucose-gated enzymatic gas therapy, promising for treating infectious diabetic bone defects.

Biography

Jiahe Li obtained a bachelor's degree in dentistry (BDS) from West China School of Stomatology, Sichuan University. He is currently pursuing a master's degree in dentistry (MDS), specializing in endodontics. He has published 5 SCI papers, with his main research focusing on bone defect repair materials and anti-caries biomaterials. He has presented academic reports at AO (Academy of Osseointegration) Conference, FDI World Dental Congress, and IADR General Session.