Controllable degradation of biodegradable metals via surface modification

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Abstract

Biodegradable metals (BMs) are metals expected to corrode gradually in vivo, with an appropriate host response elicited by released corrosion products, then dissolve completely upon fulfilling the mission to assist with tissue healing with no implant residues[1]. To date, Mg and its alloys, Fe and its alloys, Zn and its alloys, Ca-based, Sr-based and Zn-based metallic glasses had been developed as new candidates as BM. Immediately after contacting the body fluid, the BM would be oxidized into metal cations following the anodic reaction. The generated electrons are consumed by a cathodic reaction corresponding to the water reduction for Mg-based BMs and the dissolved oxygen reduction for Fe-based BMs. The interface between the BM implant and the host always keeps a dynamic balance and the host-biodegradation-products-BM double interfaces change all the time until final biodegradation of the BM. Surface modification is one of the most effective ways not only to control the degradation behavior but also to improve the surface biocompatibility. The performance criteria of an ideal BM device should perfectly match the injured tissue reconstruction process in terms of providing temporary mechanical support mimicking the near-term performance of traditional metallic implants and completely dissolve in longer time frames with an appropriate degradation rate tolerable for the human body. For example, the reported Mg-based BMs completely degraded within several months and, a much faster loss of mechanical integrity, therefore surface coating could be used as a remedy to extend the mechanical integrity of Mg-based BMs. In the case of Fe-based BMs, they exhibit good mechanical support but slow degradation, therefore surface coating could be used to accelerate the biodegradation. In this talk, the recent works by the author will be presented to show how to realize the tunable control on the biodegradation mode and rate by various surface technologies[2-10].

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