Tentative title: Novel strategies in constructing multifunctional bioabsorbable cardiovascular stents with controlled degradation

Research groups: Resource Recovery and Environmental Management (R2EM - SETRI) and Biomaterials, Biomechanics and Tissue Engineering Research Group (BBT)

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Abstract:

Metallic stents are commonly used to promote revascularization and maintain patency of plaqued or damaged arteries following balloon angioplasty. To mitigate the long-term side effects associated with corrosion-resistant stents (i.e. chronic inflammation and late stage thrombosis), a new generation of stents composed of bioabsorbable/biodegradable (BDS) materials is currently being developed. BDS provides mechanical support for over a certain period of time and after the BDS degradation, the blood vessel recovers its normal functions while the BDS eventually is absorbed by the body completely.

It is crucial to find an excellent relationship between biocompatibility and biodegradability of BDS to be a great promise of alternative solution over the metal stent. Polymers and magnesium, iron, zinc, and their related alloys, have been investigated as potential candidates. However, the degradation time of polymers of about 2 years is too long, and the uncontrollable degradation rate of magnesium within less than six month is too fast. There is still a gap between the degradation periods of existing stents and an ideal BDS degradation period, which is assumed to be about 6–12 months. Furthermore, the corrosion products, for example, lactic acid from poly(L-lactic acid) and $Mg(OH)_2$ from magnesium alloys, significantly disturb the local environment by pH shifts, osmotic changes, and unphysiologic ion concentrations. Not all of these products underwent in depth evaluation yet. Despite the impressive progress in the design of novel vascular stents, the pursuit of improving stent performance through surface modification has not stopped.

The objective of this research is to study the biodegradation behavior and mechanism of bioabsorbable/biodegradable materials with electrochemical analysis and cell *in vitro* experiments. Moreover, it will be applied surface modification techniques (i.e. functionalization or drug delivery…) for making cardiovascular stents to smart interventional devices, which can regulate blood-implant responses, control restenosis and accelerate the repair of endothelium promoting the healing of atherosclerosis.