BIODEGRADABLE Fe-BASED MATERIALS – A CRITICAL REVIEW

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Introduction

In developed countries, over 20% of deaths are caused by coronary artery disease [1]. To prevent these deaths, is used balloon angioplasty with stent insertion. However, there are still some limitations to the use of stents induced mechanical damage, tissue restenosis, or displacement of the device often necessitate re-operating the patient to remove the stent [2]. The solution to this problem would be bioabsorbable stents, which would fully degrade after a specific time. The most frequently mentioned material for this role are polymers, with polylactide as a pioneer [3]. However, their mechanical properties are poor, so there is a need to use thick walls and stent supports that negatively affect blood vessels' walls and increase the risk of their damage [4]. Therefore, metals that will degrade due to corrosion are increasingly considered suitable materials to create bioabsorbable stents. One of the most frequently mentioned potential biodegradable metals is - apart from zinc and magnesium – iron [5]. It is fully biocompatible and does not cause any toxic effects. Also, its corrosion products are fully biocompatible and tolerated by the human body. Moreover, iron mechanical properties almost perfectly match those of blood vessels. A problem that limits the use of iron as a biodegradable material is its low corrosion rate. It simply degrades too slowly, so there is a need to introduce additional modifications to the surface or structure of the entire material. Additions of other metals are also often used to induce microgalvanic corrosion. [6]. This work takes on this challenge.

Materials and Methods

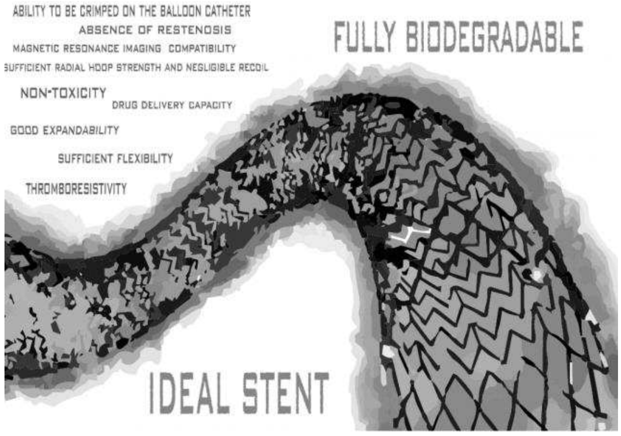
This work uses a straightforward synthesis replica method of nano- or microarchitectural iron and iron-based 3D systems; as templates, were used polyurethane foams and impregnated with the suspension of pure iron. The samples were heated in an oven at a temperature above 80°C, under inert gas conditions, for 8 hours.
The obtained samples were tested by X-ray diffraction (XRD), X-ray spectrometry (EDX), Raman spectroscopy and corrosion analysis in Hank's solution.

Results and Discussion

Research is still in its early stages. However, initial results suggest that it was possible to obtain iron-based materials with different morphology corresponding to the template structure and with a high corrosion rate but with very low mechanical parameters.

Conclusions

The initial results on the corrosion rate of the resulting iron-based materials are very promising as it has been possible to increase the corrosion rate significantly. However, poor mechanical properties prevent the use of this material in the production of a stent. Therefore, there is a need for modification by introducing additional metallic additives or coating the iron with a biodegradable polymer.



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