Optimisation of the corrosion rate of iron-based alloys for bioresorbable stent applications by surface acidification

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Biodegradable materials become progressively of interest for stent applications. However, during the corrosion of a stent in the blood environment, different layers form on top of the metal, hindering the oxygen diffusion towards the metal. Since the pH of the environment greatly influences the presence of these layers, dissolution of these layers could help in activating the corrosion. The present work thus investigates different methods that can influence the pH: dissolved hydrogen and polymer coating on Fe-based alloys.

Hydrogen charging was conducted either electrochemically, thermally or chemically on Fe-Mn-C TWIP steels also containing VC precipitates for hydrogen pinning. The effect of these carbides on the mechanical behaviour with different levels of hydrogen was studied. The influence of the hydrogen concentration on the corrosion mechanisms in SBF (simulated body fluid) is assessed by means of immersion tests as well as potentiodynamic polarisation tests. Immersion tests allow to mimic closely what happens *in vivo*, while potentiodynamic polarisation tests give a quick comparison between the different materials regarding their corrosion rates. Samples charged electrochemically showed an increased corrosion rate for samples that contained higher amounts of hydrogen (after one day of immersion). On the other hand, after three days of immersion, no significant effect could be seen. This can be explained by the fact that no hydrogen is present in the sample anymore after 3 days at room temperature (assessed by Thermal Desorption Analysis). For the polymer method, a PLA (polylactic acid) coating was performed on the Fe-Mn-C surface. It can be seen that the corrosion rate is increased after addition of this coating. This can be explained by the hydrolysis of the polymer, which acidifies the surface and dissolves the corrosion products.