Critical Factors in Mg Alloy Corrosion and Biocompatibility

Sannakaisa Virtanen
University of Erlangen-Nuremberg, Department of Materials Science, Institute for Surface Science and Corrosion
Martensstrasse 7 (WW-4), 91058 Erlangen, Germany

In recent years the interest of exploiting Mg alloy corrosion for the use of these materials in biodegradable biomedical devices has found tremendously increasing research interest. The challenges for successful applications are probably greater than expected, as in spite of the non-toxic nature of Mg ions, the side effects of Mg dissolution such as H_2 gas evolution or alkalization are of concern in view of the biocompatibility. In addition, many conventional Mg alloys seem to show too high corrosion rates in the biological environment (even though it should be mentioned that the desired corrosion rate of course very strongly depends on the targeted application).

Mg alloy corrosion has been studied *in vitro* in different types of simulated body solutions. Drastically different behaviors can be found between different formulations of solutions; in many cases the complex media used for these studies makes it challenging to attribute the specific corrosion behavior observed to a single-parameter in the electrolyte. The presentation discusses some critical factors influencing the observed corrosion rates, such as presence of proteins in the electrolyte.

Different pathways to tailor the degradation rate of Mg alloys have been proposed, including development of novel alloys as well as various surface modification approaches. The presentation will discuss recent developments in surface modification, in view of optimizing both the corrosion and the biological performance. This includes functionalization of Mg surfaces with organic molecules or protein adsorption layers, as well as coating Mg alloys with degradable polymers.

Finally, in view of increasing the understanding of *in vivo* Mg corrosion, cell culture testing on Mg surfaces was carried out. The influence of surface modification on the biological performance was studied. In addition, influence of cell adhesion layers on the corrosion behavior was studied by electrochemical impedance spectroscopy.