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Self Assembling Molecules for Corrosion Protection of Magnesium

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Self assembling molecules (SAM) can be used for the corrosion protection of non ferrous metals [1, 2]. Magnesium, as a very reactive material, was the subject for this investigation. The alloy AZ91 was treated with two types of molecules which showed a good protection capability in corrosion tests which simulate atmospheric corrosion (constant climate test according to DIN 50 017). One of the molecules was based on a phosphonic acid, the other on sulfonic acid. The influence of surface preparation (grinding without pickling or with pickling), adsorption time and temperature was proofed. From contact angle measurements, the ordering process can be followed. Electrochemical techniques have been used to characterise the corrosion process.

The adsorption and ordering process of dodecandi-phosphonic acid was followed by contact angle measurements. With increasing adsorption time, contact angle decreases. This can be explained by the polar group of the phosphonic acid which arranges more perfect with time at the surface (fig. 1).

As information about corrosion resistance impedance measurements have been performed. With increasing adsorption time the polarisation resistance increases strongly (fig. 2). Longer adsorption times in combination with higher temperatures increase the polarisation resistance further.

Polarisation curves also do show differences in corrosion behaviour. But due to the polarisation of the self assembling monolayer, the film is destroyed which leads to changes in polarisation behaviour (fig. 3).

The results did show that the dodecandiphosphonic acid is capable to protect magnesium surfaces from corrosion.

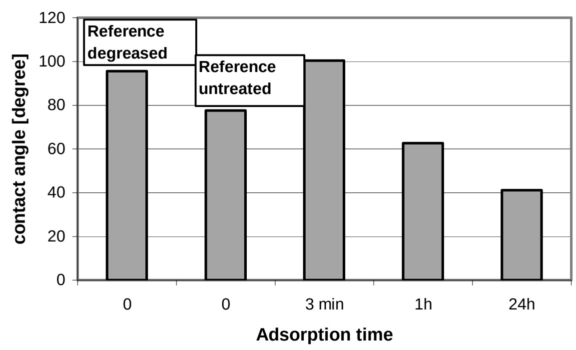

Fig. 1: Contact angle of magnesium AZ91 with dodecanediphosphonic acid as a function of adsorption time.

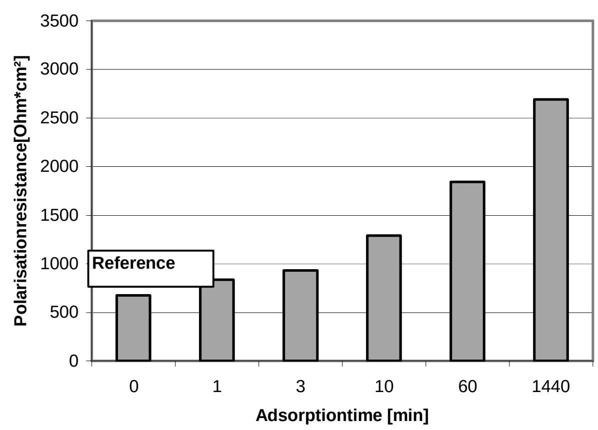

Fig. 2: Polarisation resistance of magnesium AZ91 in 0.1 m Na_2SO_4 solution with a layer of dodecanediphosphonic acid with varying adsorption time.

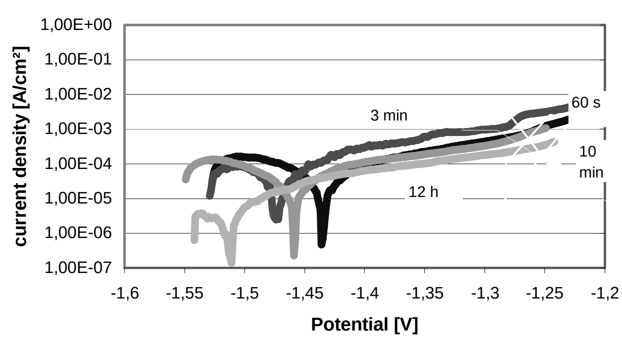

Fig. 3: Polarisation curve of magnesium AZ91 in 0.1 m Na_2SO_4 solution, with a SAM layer of dodecandiphosphonic acid.

Literature:

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Materials and Corrosion 52 (2001) 456 - 461, 2001

[2] R. Feser, A. Friedrich, H.-J. Adler
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