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Structuration of Magnesium Surface by Acoustic Cavitation

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Magnesium and its alloys are widely used in automotive, aerospace and microelectronic industries [1]. Besides, as a potential material for biomedical applications, structuring and coating of Mg and its alloys are common approaches to improve their corrosion resistance [2]. Compared to conventional methods, surface structuring by ultrasound presents the advantages of indirect contact with surfaces, unlimited shape of objects and being relatively cheap and simple.

This study focuses on the sonication effect on extended magnesium surfaces at low (20 kHz), intermediate (100-200 kHz) and high (1 MHz) frequency ultrasound in dilute oxalic acid. Sonication effects are followed by means of SEM, 3D image reconstruction, wetting behavior analysis, mass spectrometer and ICP-AES. Investigations revealed a strong ultrasonic frequency dependency of the effects generated at the metallic samples. 20 kHz leads to strong erosion and transformation of the surface with the formation of large pits, holes and channels (Fig. 1.a). 1 MHz sonication results in a smooth surface devoid of pitting. By contrast, golf-ball like extended craters and new spherical micrometric structures can be observed for intermediate frequencies (Fig. 1.b and c.). Such crater structuring is characterized by a high wetting behavior and a roughness of 170 nm measured by a 3D reconstruction program. The investigations showed that such architectures result from the ultrasonically controlled dissolution of the Mg surface. Heterogeneous nucleation provided by the creation of defects by ultrasound and the release of H₂ gas are supposed to be at the origin of the crater formation.

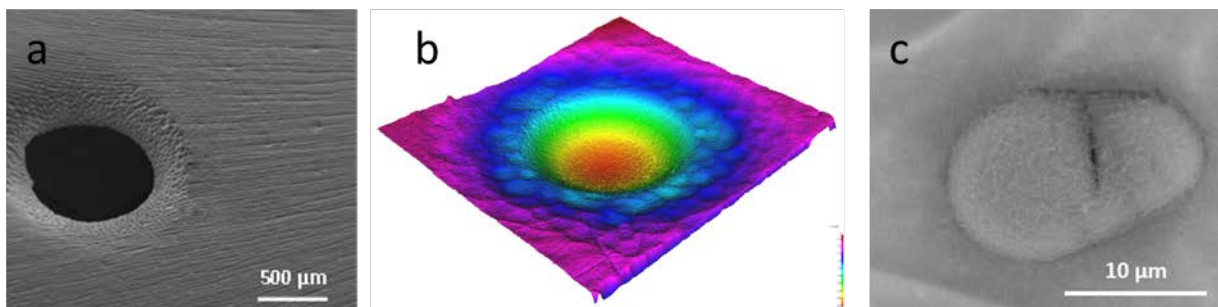


Figure 1 Images of sonicated Mg surface in 0.01 M oxalic acid: a) hole and channels at 20 kHz; b) golf-ball like extended structure at 100 kHz; c) secondary phase at 200 kHz

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[2]. Demir, A. G.; Furlan, V.; Lecis, N.; Previtali, B. *Biointerphases* **2014**, *9* (2).