

Structuration of Magnesium Surface by Acoustic Cavitation

R. Ji, M. Virot, R. Pflieger, S. I. Nikitenko

▶ To cite this version:

R. Ji, M. Virot, R. Pflieger, S. I. Nikitenko. Structuration of Magnesium Surface by Acoustic Cavitation. The 3rd Asia - Oceania Sonochemical Society conference, Sep 2017, Chennai, India. cea-02439450

HAL Id: cea-02439450 https://cea.hal.science/cea-02439450

Submitted on 14 Jan 2020 $\,$

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers. L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Structuration of Magnesium Surface by Acoustic Cavitation

Ran Ji^a, Matthieu Virot^a, Rachel Pflieger^a, Sergey I. Nikitenko^a

^a Institut de Chimie Séparative de Marcoule, UMR 5257, CEA-CNRS-UM-ENSCM, Site de Marcoule, 30207 Bagnols-sur-Cèze Cedex, France.

Email: ran.ji@cea.fr

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

[1]. Mordike, B. L.; Ebert, T. *Mater. Sci. Eng. A.* 2001, *302* (1), 37-45.
[2]. Demir, A. G.; Furlan, V.; Lecis, N.; Previtali, B. *Biointerphases* 2014, *9* (2).