Empa, Swiss Federal Laboratories for Materials Science and Technology

Laboratory for Joining Technologies & Corrosion

Empa
Materials Science and Technology

Master Project

Effect of morphology and density of Si surface precipitates on the anodizing of Al-Si alloys

Al-Si alloys are widely used for lightweight components in aerospace, cars and construction applications due to their combination of light weight, high thermal and electric conductivity, good machinability and workability. The manufacturing process of these materials generally includes several processing steps such as:

- heat treatments to optimise the properties by bulk precipitation of alloying elements and
- anodizing processes to form an oxide which leads to higher corrosion-, weathering- and wear- resistance.

The heat treatments not only lead to formation of *bulk* precipitates, but also of *surface* precipitates as a result of fast Si diffusion [1]. These can strongly affect the subsequent anodizing process. Thus, the investigation of anodizing processes of heterogeneous surfaces is highly relevant for industrial application and functionalization of structural engineering alloys.

The Laboratory of Joining Technologies and Corrosion at Empa already performed systematic investigations of the anodizing of Al-Si model substrates grown by PVD [2]: the study unveiled dramatic effects of the Si incorporation for the Al anodizing process. In the context of the proposed master thesis, the anodizing of commercially available bulk Al-Si alloys will be investigated. Different degrees of Si-enrichment on the surface, i.e. different number density, size and lateral spacing of the Si-rich surface precipitates, will be achieved by dedicated heat treatments (see Figure 1). Their influence on the anodic oxidation will be investigated using a combination of different characterization techniques including SEM, EIS and AFM.

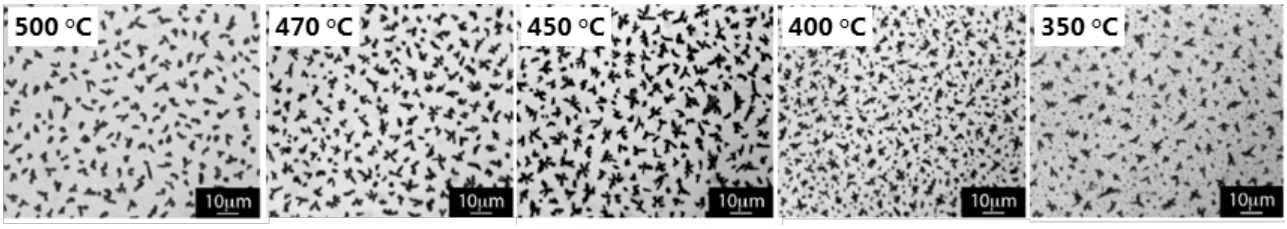

Figure 1: Optical microscopy images of Al-1.2 wt.% Si held for 30 min at different temperatures followed by water quenching (from Ref. [1]). Different shapes and densities of the Si precipitates can be observed.

Scope of the thesis

The thesis involves: (a) aspects of anodizing process technologies, (b) execution of annealing treatments for controlled formation of surface precipitates, (c) detailed characterization of surface properties. Duration: 6 months (master thesis). We are looking for motivated students in the field of Chemistry/Materials Science/Physics/Electrical Engineering willing to work in a multi-disciplinary team to carry out systematic experiments for material analysis.

Contact

If you are interested or want to learn more, please contact Dr C. Cancellieri (claudia.cancellieri@empa.ch).

[1] Y. Chen et al., Acta Materialia, 81 (2014) 291–303, [2] C. Cancellieri et al., Materials Science & Engineering B, 226 (2017) 120–131