Lisa Rullik

Making Aluminium Alloys Sweat

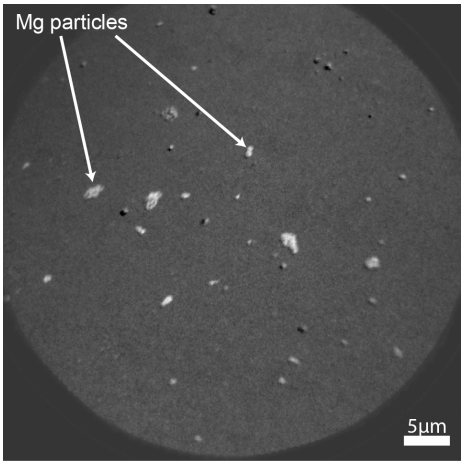
Aluminium based products, especially aluminium alloys, can be found in all aspects of everyday life. If you drive a car, drink from a beverage can or pass through a doorframe, aluminium alloys are used. To improve performance, lifetime and production of aluminium alloys, we need to know how they behave in different situations for example when you heat them.

To understand how aluminium alloys react on heat treatment is important because during the production of these alloys and the joining of different work pieces, aluminium alloys are heated. Besides aluminium several other elements are present in the alloy to give it its desired properties. All of these additional elements like magnesium, silicon and iron are influenced differently by heat.

If an aluminium alloy is exposed to an oxygen rich atmosphere like air, it forms an aluminium oxide layer on its surface within seconds. For some applications this natural occurring oxide layer provides a good corrosion protection. During brazing the oxide layer on top of the alloy is disadvantageous because it disturbs the bonding between the work pieces.

For our heating experiments we used a special type of microscope called *Spectroscopic Photoemission and Low Energy Electron Microscope*, short *SPELEEM*. The SPELEEM is situated at the national Swedish synchrotron radiation facility, MAX IV Laboratory. With this microscope images with an element specific contract can be obtained, e.g. it only shows magnesium-rich areas as bright spots as shown in the figure below. The *SPELEEM* allows taking images showing the topography of the alloys' surface, too. Further, the SPELEEM can be operated in a spectroscopy mode. Spectroscopy is the study of how matter interacts with light. Using spectroscopic techniques different chemical states of the elements in the alloy can be detected. It can be used to figure out if aluminium or aluminium oxide is present on the surface.

Using the SPELEEM in its different modes of operation we detected for both studied aluminium alloys that magnesium particles start to precipitate at the aluminium alloy surface when you heat it to 400°C.
For the aluminium alloy that is used in brazing applications we found that the aluminium oxide layer decomposes at 490°C, but that small islands of the aluminium oxide film still remain on the surface.



Supervisors: **Dr. Florian Bertram, Prof. Dr. Edvin Lundgren**
Master thesis corresponding to 30 ECTS in physics, 2014
Department of Physics, Division of Synchrotron Radiation Research, Lund University