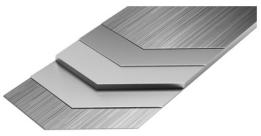
INDUSTRIAL PILOT PROJECT

In-situ investigation of grain growth and texture evolution of multilayer Al-alloys during simulated brazing using 3DXRD

THE INDUSTRIAL CHALLENGE

Heat exchanger parts in automotive applications can be exposed to a very corrosive environment that can result in tube leakage. Gränges has patented a unique product to migrate corrosion issues by engineering multilayer alloys that modifies themselves during the brazing process.



WHY USING A LARGE SCALE FACILITY

The multilayer products are rolled to a total thickness of ~ 0.3 mm or less. Cross-section electron back-scatter diffraction (EBSD) can provide ex situ 2D information of the grains in each layer. However, an in-depth understanding of recrystallization and grain growth for each layer and/or at the interfaces during brazing processes needs diffraction studies performed at very high time resolution and fine beam size. The fine beam size with high energy of synchrotron Xray diffraction allows probing each layer separately, but still penetrating through a certain height of ~ mm thick rod. The time resolution of synchrotron also allows an in-situ experiment for such a fast recrystallization process.

HOW THE WORK WAS DONE

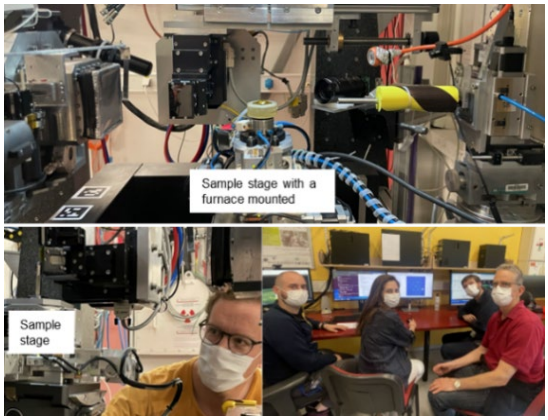


Figure 1. top: 3DXRD setup with a furnace on sample stage, bottom left: Adjustment of the sample setup for DCT measurement and bottom right: and controlling and following the experiment together with ESRF instrument scientists.

The experiments were performed on the ID11 instrument at the ESRF facility in Grenoble, France. The sample was heated during the 3D X-ray diffraction (3DXRD) experiment and measurements were performed at different heights with a 15 µm beam size to probe different layers of the sandwiched material. At each height, a full rotation of the sample was measured to access all texture components present in each layer. At the end of the recrystallization process, also diffraction contrast tomography (DCT) measurement was performed on the recrystallized sample to obtain absolute grain size and shape. Experiment was performed on two materials with slightly different compositions for different layers.

THE RESULTS AND EXPECTED IMPACT

The results showed the effect of layer composition on dominant texture components that is corelated directly with the mechanical and corrosivity properties of the material.

They also provided a detailed understanding of the texture evolution of individual layers that together are responsible for the performance of the product. Such understanding is crucial for the design and further improvement of these products. 3DXRD and DCT are both new techniques within large scale research infrastructure methods with great potential for different metallic materials.

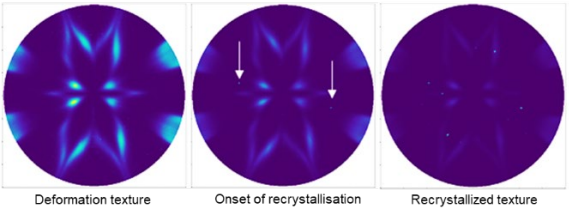


Figure 2. {111} pole figures at different temperatures show the texture evolution during recrystallisation.

"This work and technique used verifies a model for texture control and related properties very important for Gränges"
/Anders Oskarsson Gränges Finspång AB

GRÄNGES

SWERIM

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