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This experiment was designed to study the influence of process parameters on the precipitates microstructure of friction stir welded (FSW) Al-Li-Cu alloys. The precipitates distribution strongly influences the mechanical properties of these structurally strengthened alloys, as well as other properties (corrosion…). FSW welds of the same 2050 Al-Li-Cu alloys were prepared by varying the rotation speed of the tool, the advancement speed of the tool and the backing plate material.

We also studied the influence of a post-welding in treatment by heating the 5 prepared welds at 155°C in an oil bath for a further 15h. In total we studied 5x2=10 welds. Each sample was a slice of the welded structure, and we raster scanned the beam with a scanning step of 250µm, i.e. close to the dimension of the beam itself.

We setup D2AM SAXS installation as follows. The energy was 13keV. To capture both the precipitates dimensions and to differentiate their phase, we used 2 detectors for simultaneous SAXS and WAXS measurements. The WAXS signal was recorded on the custom IMXPAD WOS hybrid pixel detector (which has a hole for the vacuum tube with the continuing SAXS signal) and the SAXS signal was recorded on the IMXPAD D5 hybrid pixel detector. The former was positioned at about 11cm from the sample while the latter was at about 90cm.

The experiment went very satisfactorily. Full mappings of the 11 sampes were successfully recorded, resulting in ~4000 SAXS patterns and ~4000 WAXS patterns per sample, i.e. more than 40 000 images to interpret. The SAXS interpretation was performed in the same way than in [1,2].

We show an example of SAXS interpretation for a sample, with and without post welding treatment, on Fig. 1.

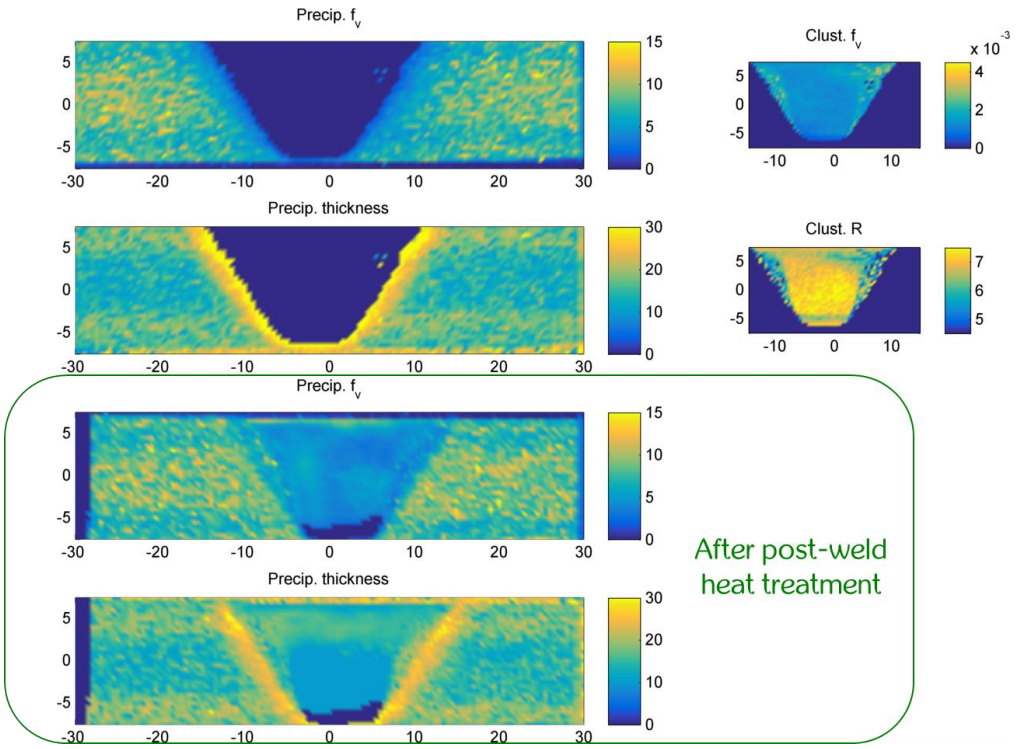

Fig. 1: microstructure mapping obtained on an Al-Li-Cu with and without post-weld heat treatment.

It very clearly shows the dissolution of the precipitates at the centre of the weld, and coarsening of the precipitates close to the dissolution zone. The post-weld heat treatment partially recover the precipitation.

The WAXS data interpretation is very complex and is still underway. Maps of the intensity of the various Bragg peaks of the diffraction patterns highlight differents zones and are likely to prove extremely useful, once full indexation is performed (see examples on Fig. 2).

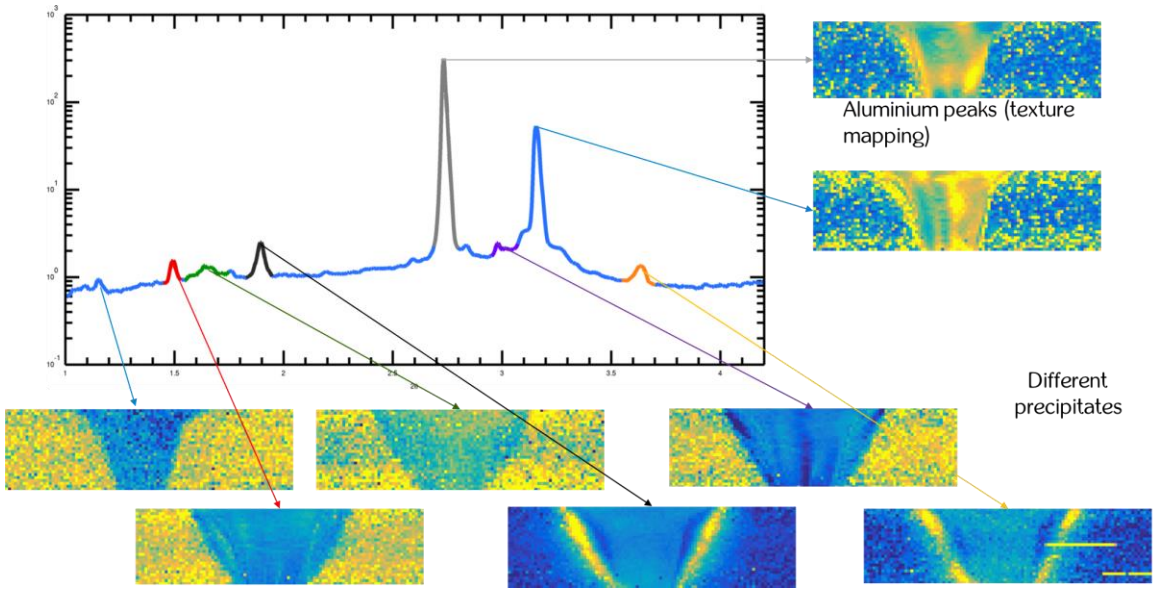

Fig. 2 maps obtained on the various Bragg peaks in the WAXS signal. Indexation in underway.

The experiment is a clear success and is likely to lead to better understanding of the effect of the process parameters on the properties of the Al-Li-Cu FSW welds. At least one high level publication is under preparation.

References

[1] De Geuser F, Malard B, Deschamps A. Microstructure mapping of a friction stir welded AA2050 Al–Li–Cu in the T8 state. Philos Mag 2014;94:1451–62. doi:10.1080/14786435.2014.887862.

[2] Malard B, De Geuser F, Deschamps A. Microstructure distribution in an AA2050 T34 friction stir weld and its evolution during post-welding heat treatment. Acta Mater 2015;101:90–100. doi:10.1016/j.actamat.2015.08.068.