# Material characterization of laser beam welded Al-alloys (AA5083H111; AA6013T6)

**Technical Report** · January 2005



**7 authors**, including:

Heinz-Günter Brokmeier
Technische Universität Clausthal
**373** PUBLICATIONS **3,404** CITATIONS



V. Ventzke
Helmholtz-Zentrum Geesthacht
**53** PUBLICATIONS **567** CITATIONS



M. Koçak
Gedik Holding, Gedik University
**186** PUBLICATIONS **2,965** CITATIONS

# Material characterization of laser beam welded Al-alloys (AA5083H111; AA6013T6)

*S. Lenser[1,2], S.-J. Jin[1,2], B. Schwebke[1,2], H.-G. Brokmeier[1,2], V. Ventzke[2], M. Kocak[2] and J. Homeyer[3]*

*[1]Institut für Werkstoffkunde und Werkstofftechnik der Technischen Universität Clausthal, Germany*
*[2]GKSS-Forschungszentrum, Max-Planck-Straße, D-21502 Geesthacht, Germany*
*[3]HASYLAB at DESY, Notkestr. 85, D-22603 Hamburg, Germany*

Aluminium is the most heavily consumed non-ferrous metal in the world. Its unique properties such as light weight, high strength and resistance to corrosion make it an ideal material for use in conventional and novel applications. Aluminium has already become important in the production of automobiles, aerospace parts and the manufacture of machinery. Aluminium users have to explore new process technologies in order to reduce production costs and make aluminium even more competitive. Laser beam welding is a new method in the handling of aluminium. However it is difficult to weld Al-sheets with high quality using a laser beam [1].

In this report we will describe the results of d-spacing and texture analysis for laser beam welded rolled sheets of AA5083H111 and AA6013T6. The laser beam welding has been carried out at the rates of 1.8 m/min and 2.6 m/min. The modification of the basic material in and near the welding seam is of particular interest. The measurements were performed at the high field wiggler BW5 with a 2-dimensional image plate detector (MAR345) at 100 keV. The z-position was scanned in steps of 0.5 mm [2].

The figures 1 and 2 show the d-spacing parallel and perpendicular respectively to the welding seam in consideration of both welding rates. The central margin, -2 mm to 2mm, indicates the position of the welded seam with basic material on either side.
The $d_{hkl}$ are calculated from the measured (3 1 1)-reflection.

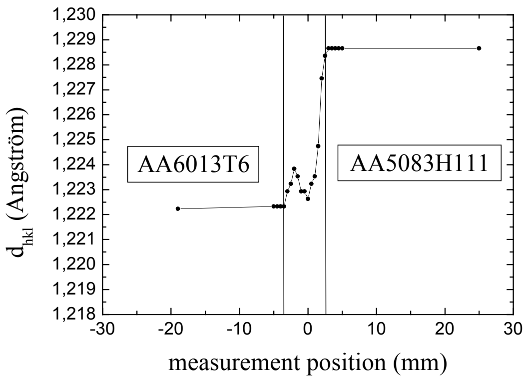


Figure 1a: $d_{hkl}$ parallel to the welding seam, welding rate: 1.8 m/min

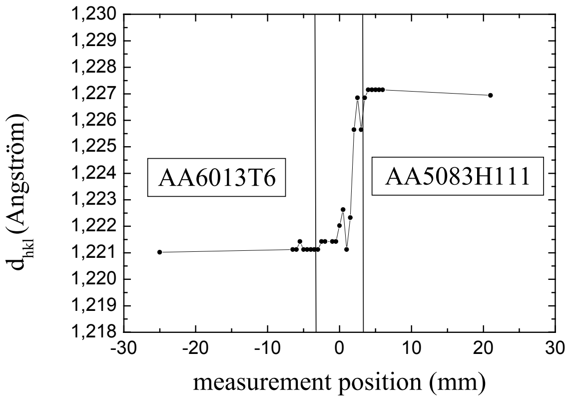


Figure 1b: $d_{hkl}$ parallel to the welding seam, welding rate: 2.6 m/min

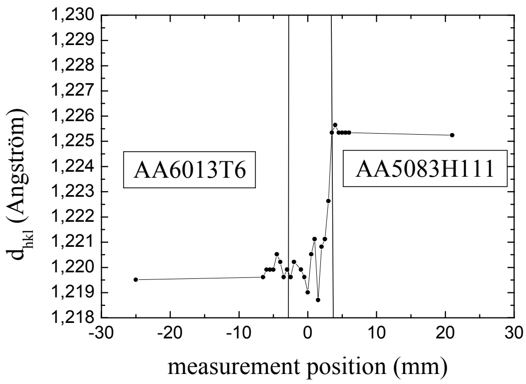


Figure 2a: $d_{hkl}$ perpendicular to the welding seam, welding rate: 1.8 m/min

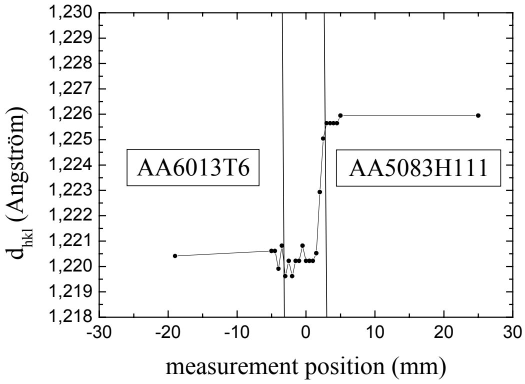


Figure 2b: $d_{hkl}$ perpendicular to the welding seam, welding rate: 2.6 m/min

The curve in the basic material is nearly constant whereas in the welding zone a transition between the base materials occurs. This indicates a different grain size and chemical composition in the welded region.
Secondly we consider the texture analysis of the basic materials. Complete pole figures for (111), (200) and (220) were measured at different positions and used to calculate the ODF.

(a)

(b)

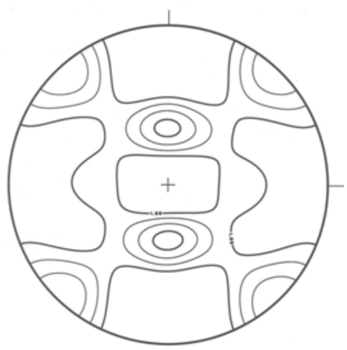

Figure 3: Recalculated (111) pole figures of the basic Al-materials
(a) AA5083H111, $P_{max}$ = 1.78 multiple random degree, mrd
(b) AA6013T6, $P_{max}$ = 1.87 multiple random degree, mrd

The texture of AA5083H111 can be characterized by a combination of a Goss component and a weak cube component whilst the texture of AA6013T6 can be characterized by a combination of a strong cube component and a deformation component. Goss and cube components are typical for aluminium. The cube component and the deformation component are the results of the pre-treatment of the Al-sheets. Furthermore the cube component occurs during crystallization.
The data will help to understand and describe the influence of the laser beam welding seam onto investigated material.

## References

[1] G.E.Totton, D.S. MacKenzie, Handbook of Aluminium, Volume1 (2003)
[2] H.F. Poulsen, S. Garbe, T. Lorenken, D. Juul, Jensen F.W. Poulsen, N.H. Andersen,T. Feidenhans´l, H. Graafsma, J. Synchrotron Rad. Bd. 4, 572 (1997)