

MetPrep Application Notes – Application Note – 004

The use of Vibratory Polishing in the Preparation  
of an Aluminium 1070 Alloy for EBSD



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## Introduction

The preparation of Aluminium alloys can often prove problematic due to their inherent mechanical properties. These problems become increasingly more difficult as you move to the purer alloys. Being soft and very ductile as the alloy content decreases, problems of impressed abrasives and smearing can be regularly encountered. This applies to routine preparation for general microstructural examination let alone the extra quality of surface required for EBSD Electron Backscatter Diffraction examination.

EBSD is a technique based around a Scanning Electron Microscopy (SEM) that allows the some of the backscattered electrons of a sample struck with the focused electron beam to form Kikuchi bands. Evaluation at different points using a chosen pattern on the sample can create detailed textural information and generate images of multicoloured grain structures. This allows full crystallographic analysis to be carried out.

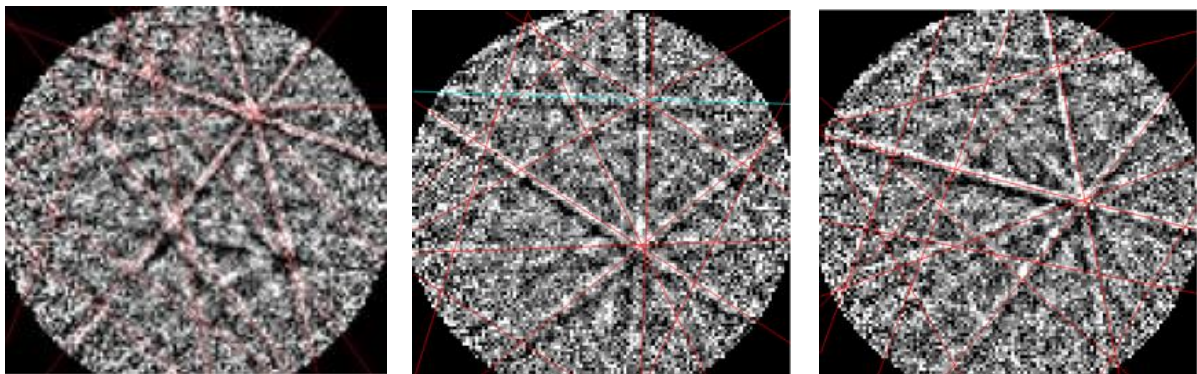


Fig 1 Kikuchi bands from the EBSD of Aluminium alloy 1070A

## The sample

MetPrep were approached by a student in the Department of Mechanical Engineering at Imperial Colleges regarding the preparation of a particular Aluminium alloy identified as AA1070. The sample had been hot extruded at 450 C and held at temperature for 30 minutes before being allowed to cool to room temperature.

The aluminium alloy AA1070 is nominally a 99.7% pure aluminium alloy with the greatest addition being 0.25% Fe. Therefore, the hardness is very low at a nominal 20Hv and soft enough to cause real problems during metallographic preparation.

## Solution

Preparation had already been tried by the operator using a range of Silicon Carbide papers. P800g, P1200g, P2500g, P4000g and followed by a hard chemotextile Planocloth with 6um diamond, followed by 1um diamond on a napped Alpha Cloth. The sample was then finish polished on Alpha Cloth using a 0.04um OPUS colloidal Silica. Initial results were disappointing and it was then that it was realised that preparation would be a little more difficult.

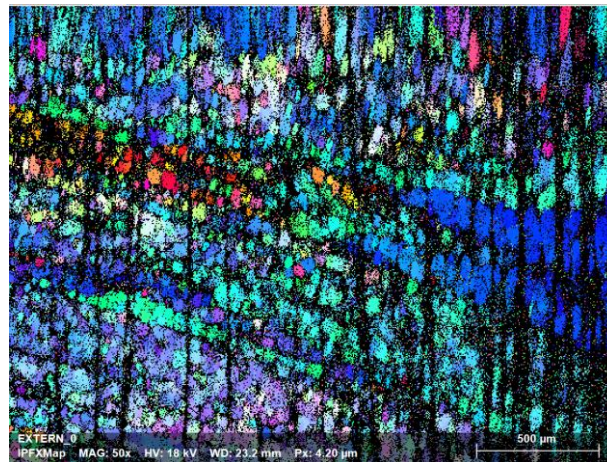


Fig 2 EBSD results after initial attempt at preparation

The operator decided then that they would manually prepare the sample to get a feel for the action of the abrasives on the surface and also by checking regularly that the damage from the previous stages was being removed. Not always that easy to see when Silicon Carbide is being used. This technique followed by an extensive final polish with OPUS colloidal Silica on Alpha Cloth did improve the surface but it was still lacking in the quality required for EBSD. The sample was still showing evidence of earlier stage Silicon Carbide damage. That said the areas between these large scratches looked better and the Silicon Carbide scratch issue could actually be addressed later.

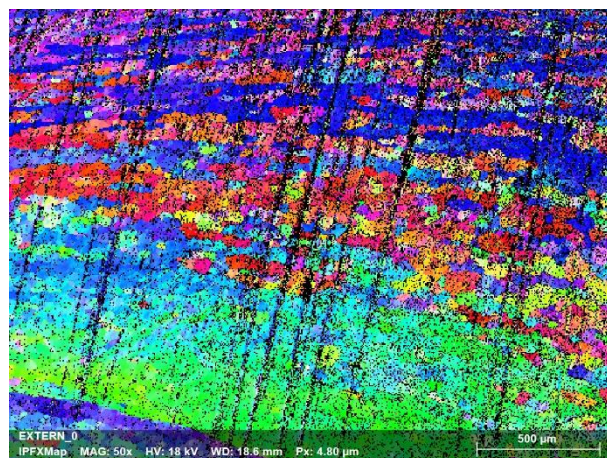


Fig 3 EBSD results after further progress in the preparation techniques



It was here that MetPrep were asked to assist and vibratory polishing was suggested as a means of generating the required surface for EBSD. Whilst vibratory polishing will not remove earlier stage damage it will certainly increase the surface quality of the better prepared areas. Using the low napped Multicloth with 0.04um OPUS colloidal silica suspension the samples were left on overnight to give a gentle but meaningful stock removal and final polish. After a total of 14 hours completed on the Saphir Vibro vibratory polisher the required surface finish was obtained

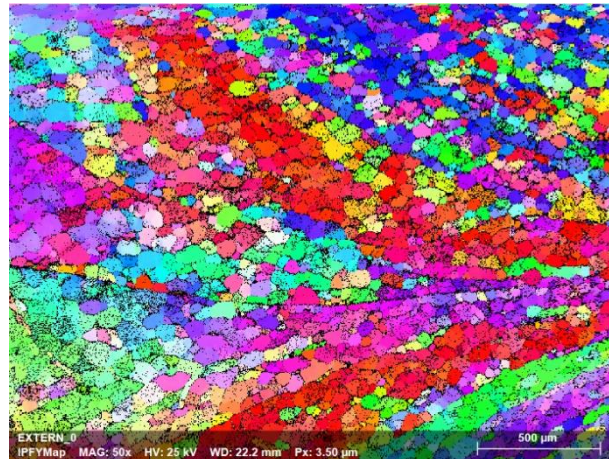


Fig 4 EBSD results after preparation using the Saphir Vibro. A crisp, clean structure revealed

### Summary

Further work on improving the earlier preparation stages may well improve the final finish & reduce preparation times but either way the required data can now be obtained from the sample. It always important to start with a good quality preparation before using the vibratory polishing technique as it will not remove serious damage but it will improve on a reasonably prepared surface.

Another benefit of vibratory polishing is that it does not require the use of aggressive and potentially explosive chemicals that electropolishing does, an option that was also considered in this case.

What is clear is that the combination of the Saphir Vibro vibratory polisher, with the correct cloth and correct abrasive, can both easily and efficiently generate the required surface finish to allow full EBSD analysis. Not only are the results excellent but there is little operator time required and only a small number of consumables are needed.

### Acknowledgements

Special thanks to Xiaocheng Lu and Ruth Brooker at Imperial College, Dept of Mechanical Engineering for their interest and work on this application.

## References

- 1) Aluminum 1070 Alloy (UNS A91070) -  
<https://www.azom.com/article.aspx?ArticleID=8692>

## Additonal information

The MetPrep web site can be found at <https://metprep.co.uk/>

Further information on the Saphir Vibro can be found here

<https://metprep.co.uk/product/vibratory-polisher/>

A video showing the operation of the Saphir Vibro can also be viewed on our YouTube Channel from the above page

Details concerning the Multicloth M our low napped final polishing cloth can be viewed here

<https://metprep.co.uk/wp-content/uploads/2016/03/TDS0030-Metprep-Final-Polishing-cloths-Multicloth-30.pdf>

Details of the OPUS colloidal Silica can be found here

<https://metprep.co.uk/wp-content/uploads/2016/06/TDS0047-Colloidal-Silica-Suspensions.pdf>

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