Ion Beam Etching of Metal Composites using Gatan’s PECS
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Introduction
In general it’s not possible to reveal the structure of all phases in a composite simultaneously by conventional etching methods if the components differ in their chemical properties. Ion Beam Etching Techniques however work in many of these cases. So one of the more important applications for this method in metallography is etching of metal combinations with extreme difference in chemical potential. This work presents composite materials from various manufacturing processes that were etched by ion beam. Application examples include build-up welds made out of Nickel containing weld material on plain steel or GGG40, welds with a Ni interface layer, and corrosion or wear protection layers produced by powder metallurgical processes. The differences in chemical composition between substrate and surface layer are demonstrated by corresponding Electron Microprobe profiles.

Test Procedure and Results
The ion beam etching was performed in a Gatan PECS (Precision Etching and Coating System). The broad beam ion source in this system generates a 10 mm beam diameter at vertical incidence to the sample, depending on the ion gun parameters (ion gun voltage and ion gun current). By tilting the specimen, i.e. by altering the incident angle, the etch mark can be enlarged further if the specimen is rotated during the process.

Although the chemical compositions of the metals that build up the composites are very different, ion beam etching reveals the structure of both compounds equally and simultaneously. DIC (Differential Interference Contrast) should be used to enhance the characteristic contrast that stems from the etching due to ion bombardment. Perlitic and martensitic textures should be treated with Nital after ion beam etching to further enhance the contrast.

Closing Remark
Sputtering yields of the individual compounds plays an important role in optimizing ion beam etching of composite materials. Although the chemical characteristics of surface layer and substrate reveal enormous differences the sputtering yields are similar. Both compound partners could be etched simultaneously and equally.

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