

A novel approach to prepare TEM lamellae with FIB for characterisation of cryo-rolled Ti laminates

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Bulk fabrication of multilayer metallic laminates using severe plastic deformation (SPD) techniques, such as cryo-rolling, has showed promising outcomes for streamline production of ultra-fine grained (UFG) materials with superior mechanical properties [1]. Characterization of cryo-rolled Ti laminate requires electron-transparent thin lamellae to be retrieved from region of interest with uniform thickness for further analysis with transmission electron microscopy (TEM). Focused ion beam (FIB) technique is suitable for this application. But the bottleneck problem is that this type of lamellae tends to bend when it was thinning down to about 200 nm thick due to relieve of the significant residue stress within the material. A series of patterning experiments were carried out for the systematic feasibility studies. It was found that the diamond shaped trenches, as showed in Figure 1, exhibited the most effective way for relieve of the residue stress in the in-plane directions parallel to the lamella surface, which minimized the displace movement in the normal direction of the lamellae. This approach could be used to establish the standard benchmark for FIB process on characterization of all the materials with high residue stress, such as metallic glass, thick coating layered materials, multiphase interface, etc.

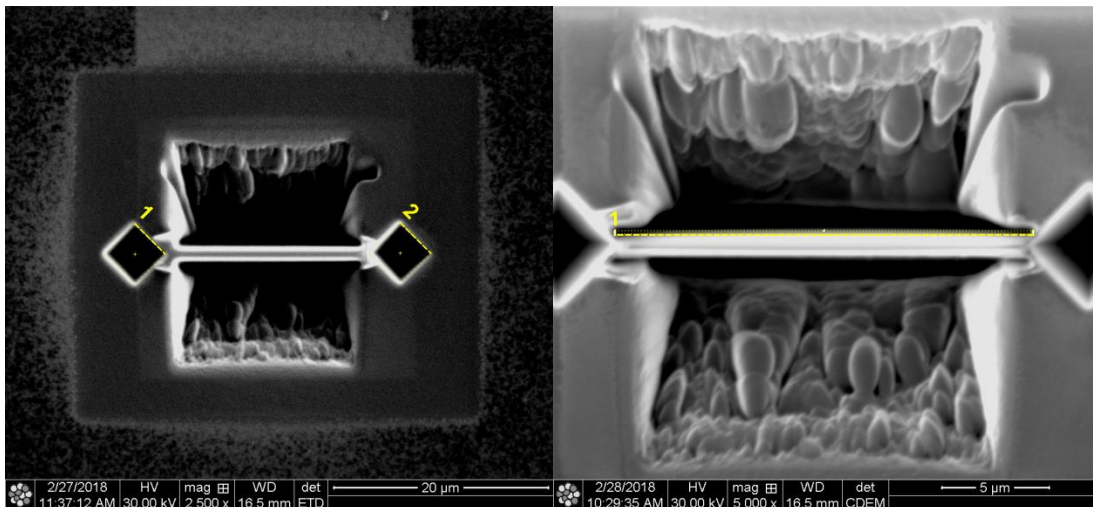


Figure 1, FIB patterning for fabrication of a TEM lamella from the Ti laminate with severe residue stress.

Reference

[1] Yu, H.; Lu, C.; Tieu, K.; Li, H.; Godbole, A.; Liu, X.; Kong, C., Enhanced materials performance of Al/Ti/Al laminate sheets subjected to cryogenic roll bonding. *Journal of Materials Research* 32 (2017) 3761-3768.

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