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Effect of H^+ Irradiation on the High-Pressure Torsion Deformed Nb-1wt.%Zr Alloy

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The effect of 5.6 MeV proton irradiation on the microstructure and mechanical properties of coarse grained (CG) and nanocrystalline (NC) Nb-1wt.%Zr (NZ) was investigated. Bulk nanocrystalline microstructure was obtained by subjecting the alloy to room temperature high pressure torsion under 6 GPa hydrostatic pressure and 5 rotations. The CG and NC samples were irradiated at doses of $1.9x10^{17}$ p/cm^2 and $1.8x10^{17}$ p/cm^2, respectively. Microstructural parameters like crystallite size, dislocation density and dislocation arrangements were studied in detail using X-ray line profile analysis (XLPA) by Convolutional Multiple Whole Profile (CMWP) fitting. Microscopic observations were made with electron microscopy techniques in the scanning and transmission modes. Tensile tests of CG and NC irradiated samples were performed and compared to the unirradiated condition. While in the NC condition, irradiated sample showed higher ultimate tensile strength and average work hardening rate as compared to the unirradiated condition, the CG irradiated sample showed a completely brittle fracture as shown in Figure 1. Dimple sizes in NC unirradiated condition were larger than that in the irradiated condition, and therefore the fracture mechanism was explored.

Keywords: Nb-1Zr, Nanocrystalline material, Irradiation effect, Microstructure, Mechanical Property

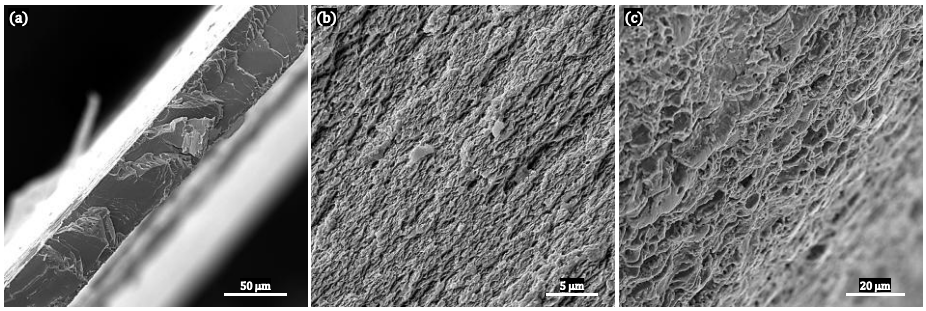

Fig.1: Fracture surfaces of tensile tested Nb-1Zr for the following conditions: (a) irradiated CG, (b) irradiated 5R HPT, and (c) unirradiated 5R HPT.

References:

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