Section V Ultrafine-grained/Nanocrystalline materials
Place: *Li De Hall, H2*
Chair: *Dr. Hyoung Seop Kim*
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ID B13: Microstructural evolution in ultrafine-grained Ti-6Al-4V alloy processed by high-pressure torsion

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Abstract: A commercial cold-rolled Ti-6Al-4V sheet with a thickness of 2.3 mm was used, Prior to processing by HPT, a heat treatment was subjected to a recrystallization annealing by heating to 1073 K for 45 minutes, then air cooled to room temperature (RT), attaining equiaxed α (~90% vol%) and a small quantity of lamellar (α+β) microstructure (~10%). The grain size in the unprocessed condition was approximately 10 m by statistical analysis. The processing by HPT was performed at room temperature with a pressure of 6.0 GPa and a rotation speed of 1 rpm. Processing of the material was conducted through a total number of revolutions, N, of 1/4, 1/2, 1, 2, 5, 10 and 20. With the increase of the turns, the inhomogeneous areas of the center gradually decreased. In the primary stage, deformation was not very homogeneous. After 1 turn, traces of shear deformation appear and the SAED pattern exhibited individual spots. When the numbers of turns increased to 5, it could be seen that the shear deformation was more severe, an increased dislocation density and finer grains were observed. The diffraction pattern was nearly ring-like. After 10 turns, the diffraction patterns were now more diffuse, indicating that high-angle boundaries had formed. When the deformation increased to 20 turns, Debye rings appeared which meant that more high-angle boundaries were formed. The average size of these equiaxed grains was less than 100 nm. After HPT for 1/4 turn, the microhardness remarkably increased. After 1 turn, the value increased but not obviously. From 1 to 20 turns, the microhardness gradually increased, the microhardness and the turns approximately linearly distributed. Meanwhile stress or strain induced β→α/α´ transformation occurred in the process of HPT.

Keywords: Ti-6Al-4V alloy, high pressure torsion, grain refinement, microhardness