Effect of deformation-induced adiabatic heating on microstructure evolution during open-die screw press forging of Ti-6Al-4V

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Microstructure evolution was investigated in a Ti-6Al-4V alloy having a coarse lath structure within large primary β grains, during hot forging using a 2100t screw press. A double truncated cone (DTC) sample, with 120 mm maximum diameter and XX height, was hot forged at 970°C (i.e. below β transus) to 60% of its height using the full capacity of the press (i.e. over 80% of the available energy), followed by air cooling. A finite element (FE) model of the forging process was also developed. A wide range of strains (i.e. 0.3 to 2.5) was generated in the mid-height of the DTC's cross-section area . The adiabatic heating generated by the high deformation rate (i.e. up to $47s^{-1}$) caused a temperature rise by as much as 60°C which is enough to go beyond the β transus. Microstructural investigations of the final forged material show the presence of primary α and secondary α/ β phases. Primary α was uniformly distributed throughout the specimen's cross-section disregarding the strain rate level during forging, implying XXX. Local disorientation due to forging induce deformation is observed within primary α grains. This implies that the deformation-induced adiabatic heating level was not high enough to increase the temperature significantly to trigger α-β phase transformation. This is in a good agreement with the results of FE model, as the predicted temperature rise induced by adiabatic heating was also not sufficient to keep the material above β-transus long enough to cause phase transformation.