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Lamella orientation control of β-Solidifying TNM Alloys via High-Temperature Compression

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The third generation β-solidifying TNM alloys with (α2+γ) lamellar microstructures have been considered excellent candidates for modern turbine blades due to their low density, high specific strength and stiffness, excellent creep resistance, and good corrosion resistance. It has been found that orienting the γ lamellae to the direction of the load can significantly increase the mechanical properties of the alloys, making lamella orientation control (texturization) an interesting topic for property optimization [1].
In this study, high-temperature compression (with a dilatometer) was first achieved to texturize the alpha phase through optimization of compressive speed and strain. An optimum fiber texture for the alpha phase has been identified by combining EBSD analysis with an in-situ XRD synchrotron.
Moreover, experiments were performed to observe the effect of the strain rates, taking a high strain rate of 1 s-1 and low strain rate of 10-2 s-1 while keeping the other parameters constant (cooling rates, externally applied load during cooling, total deformation, and temperature). A difference in behavior for the true stress-strain curve has been highlighted corresponding to a different type of mechanisms of dynamic recrystallization.
Our results show that the microstructure and texture of TiAl alloys can be effectively controlled, and it seems that having a high deformation and a low strain rate should promote the uniform fiber texture.
Further analyses are needed to understand the mechanisms behind the observed texture evolution. These findings have potential implications for optimizing the processing and performance of TiAl alloys.

[1] « Polysynthetic twinned TiAl single crystals for high-temperature applications » Chen et al. Nature Materials vol.15 August 2016

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