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In-Situ Thermo-Mechanical Simulation in Titanium Aluminides

A hot-compression test has been undertaken in a high-energy synchrotron X-ray beam to study in-situ and in real time the bulk of a novel, β-solidifying titanium aluminide alloy. The occupancy and spottiness of the diffraction rings (Fig 1) is evaluated (Fig 2)in order to access grain statistics, such as grain growth / refinement, orientation relationships, subgrain formation, dynamic recovery and dynamic recrystallization as well as phase transformations. For the first time, this method has been applied to an alloy consisting of two co-existing phases at high temperatures and it is found, that the *bcc* β-phase dynamically recrystallizes much faster than the *hcp* α-phase which deforms dominantly through crystallographic slip underpinned by a dynamic recovery process and only little by dynamic recrystallization. It is found, that the two phases deform mostly independently besides each other. The rapid recrystallization dynamics of the β-phase combined with the easy and isotropic slip characteristics of the *bcc* structure explain the excellent deformation behavior of the material. The presence of two phases suppresses grain growth effects efficiently.

Publication: K.-D. Liss, T. Schmoelzer, K. Yan, M. Reid, M. Peel, R. Dippenaar, H. Clemens: *"Dynamics of hot-deformation in multi-phase TiAl based intermetallics studied in-situ by time-resolved high energy X-ray diffraction"*, to be submitted

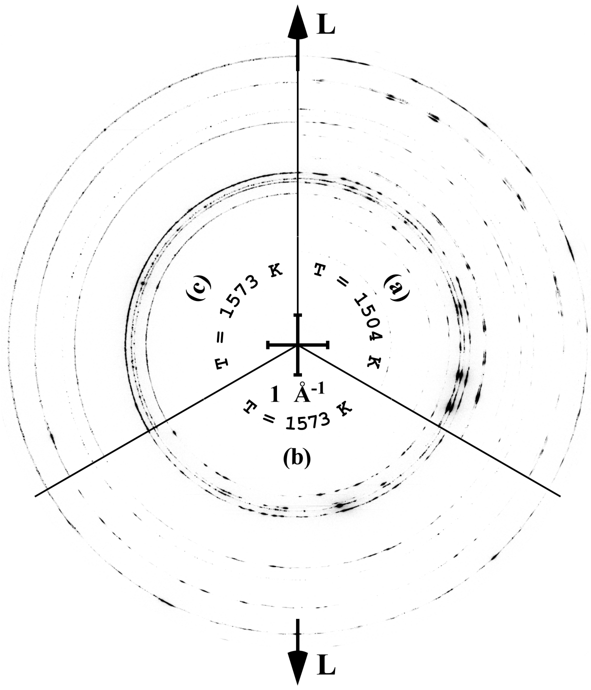

Figure 1: *Representative parts of the acquired diffraction rings compiled in 3 sectors: (a) below the alpha transus temperature T_α, showing α-, β- and γ-phases in co-existence; (b) above T_α, where γ disappeared before plastic deformation and (c) above T_α during plastic deformation. The common ring center is marked with a crossed scale bar of 1 $Å^{-1}$ and the longitudinal load direction **L** is indicated.*

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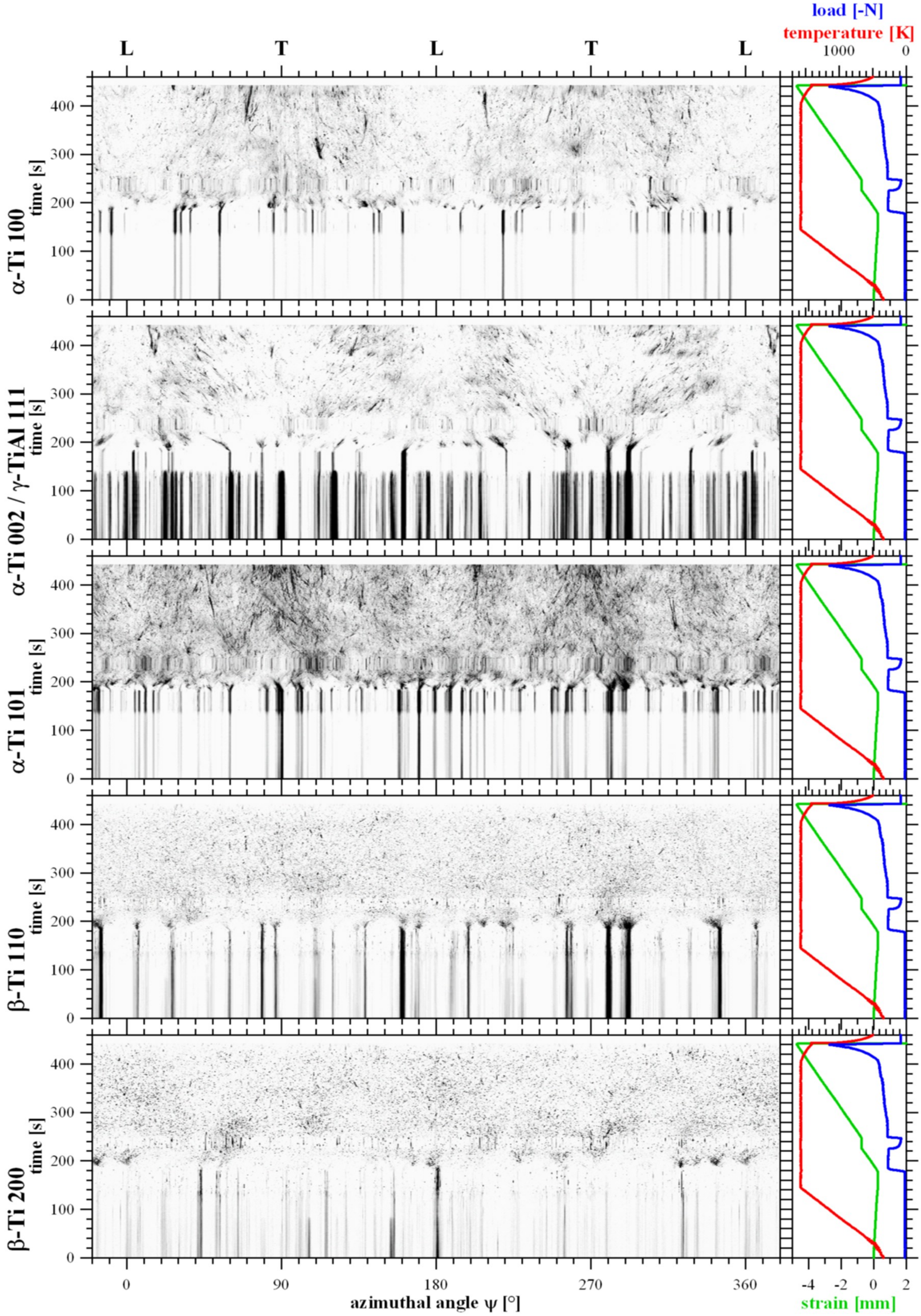

Figure 2: *Azimuthal-angle-time plots of the first three α- and two β-reflections. The α-002 and γ-111 reflections overlap and cannot be separated until the γ-phase disappears at the α-transus temperature. The initially static grain statistics evolves turbulently upon the application of strain and pauses when strain is held for a while, as indicated by the deformation parameters to the right of each plot. Longitudinal and transverse load directions,* ***L*** *and* ***T****, respectively, are given at the top of the azimuthal-angle axis.*