High Temperature Deformation Studies of Metals

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Physical thermo-mechanic simulation of metals is an important laboratory method to develop microstructures exposing desired mechanical properties; to engineer processing routes in manufacturing; and to establish lifetime and performance predictions. While most of the investigations are undertaken post processing, modern diffraction methods using neutrons or synchrotron radiation allow to get immediate feedback, in-situ and in real time. Neutrons deliver a meaningful bulk average, as it is important for quantitative phase analysis, strain scanning and texture determination. In contrast, well-bundled high-energy X-rays allow to obtain information from an ensemble of individual grains, showing formation of subgrains, grain rotation, recovery, recrystallization.

Data from the Takumi beamline at J-PARC demonstrates not only the response of lattice parameters to heating and underpinning phase transformations, but moreover the extraction of the defect kinetics in titanium and zirconium alloys at high temperatures and under plastic deformation. A recently developed method employing the effect of primary extinction of radiation is being applied for this purpose. Moreover, aluminium, copper and magnesium have been studied on heating ramps in order to extract the rearrangements of microstructure.

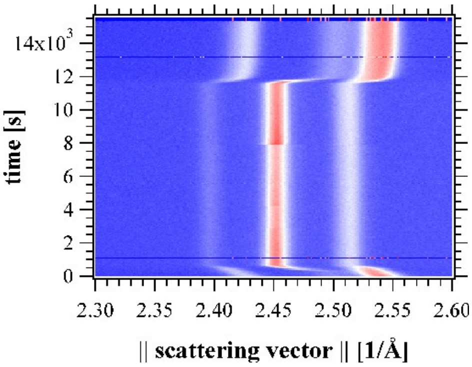

Figure: The central line represents the β-Zr 110 reflection, showing extinction and change of reflectivity upon plastic deformation at 8000 s.

The neutron data will be complemented by experimental achievements using high-energy synchrotron radiation, and the vision of a *Materials Oscilloscope* is presented.

References

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