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# Modern diffraction methods for the investigation of thermo-mechanical processes

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The development, processing and functionality of metals and alloys is a fine-tune between atomic structure, microstructure and mechanical properties of a final product. In-situ neutron and synchrotron X-ray diffraction deliver unique and complementary insight into the microstructural evolution of metals under various conditions, such as at high or low temperature, pressure and plastic deformation. Neutrons illuminate a larger bulk volume and reveal quantitative phase abundance, bulk texture, lattice parameter changes and other ensemble averaged quantities. Scattering contrasts complementary to X-rays can reveal atomic disorder in ordered intermetallics, particularly titanium alloys, while the dynamical theory of diffraction has been employed to study their defect kinetics at very high temperature. In contrast, fine-bundled high-energy X-rays deliver reflections from a number of individual grains. For each constituting phase, their statistics and behavior in time reveal information about grain growth or refinement, subgrain formation, static and dynamic recovery and recrystallization, slip systems, twinning, etc. A review on example systems is given with an outlook to the Materials Oscilloscope.

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