Time resolved computed tomography/tomoscopy

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Time-resolved in-situ and operando tomography is increasingly moving into the focus of materials research. Improvements in time and spatial resolution will be presented, which allow for an analysis of fast phenomena and detailed 3D process imaging. We apply real-time in-situ tomography with acquisitions rates of up to 1000 tomograms per second, which we call “tomoscopy”. The sample environment is composed of IR lamps or an IR laser for contactless heating of the X-ray transparent crucible made from boron nitride into which samples are placed. Temperature is measured and controlled using a pyrometer. We show how fast tomography can be combined with simultaneous energy-dispersive diffraction, which is of special interest in cases where structural or morphological changes are correlated with chemical reactions or phase transformations caused, for example, by temperature variations. Some recent results and case studies include: (i) An analysis of the growth and evolution of liquid metal foams, where knowledge about the mechanisms of bubble formation, growth and degradation is gained. (ii) The immiscible hypermonotectic reaction of AlBi10 (in wt%) alloy and (iii) dendrite evolution in AlGe10 (in wt%) casting alloy during fast solidification. (iv) The combustion process and the evolution of the constituents in a burning sparkler. (v) The structure and density of two metal foams over a long period of time and derive details of bubble formation and bubble ageing including quantitative analyses of bubble parameters with millisecond temporal resolution. The work is performed at our own facility at EDDI, Bessy II, Berlin as well as at the Tomcat beamline, SLS, Villigen.