Use of Synchrotron Radiation Methods for the In-Situ Real-Time Monitoring of Microwave Heating

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Progress in understanding the dynamic evolution of microstructure, dielectric properties and physical behavior of heterogeneous solids holds the key for new applications based on the electromagnetic processing of materials. We describe recent advances of our group in developing portable microwave heating equipment and its use in time-resolved synchrotron radiation experiments. In-situ microwave heating experiments (real-time X-ray diffraction, micro-tomography) performed at the Swiss Light Source enabled the detailed observation of structural phase transitions, sintering, wetting, thermal expansion and grain growth processes in various composite materials. Computational efforts devoted to the coupled thermo-mechanical modeling of microwave radiation effects on organic, inorganic and biomaterials will thus soon receive a sounder experimental basis. Moreover, the kinetics of mass transport processes under microwave fields may now be investigated in detail.