Microwave processing of materials: current limitations and hopes

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The increasing availability of nanopowders, is calling for advances in processing technologies materials, in order to convey, press, and consolidate nanomaterials, while retaining their structural confinement. While conventional sintering fails, faster sintering methods such as spark plasma sintering (SPS), and microwave assisted sintering are promising alternatives. However, a careful control of the process remains limited today. Direct access to parameters such as temperature, chemistry and microstructure could be helpful to understand microwave heating in more details, with the ultimate goal of defining more clearly the areas in which microwave can offer unique features. Here we show that complex temperature distribution in a sample under irradiation can be adresse at several scales. While microwave radiometry can be used to follow volumetrically the thermal trajectory of microwave heated aluminium powder, in-situ Raman spectroscopy is shown to evidence microscale thermal gradients between diamond and silicon grains in a binary powder mixture. Finally, perspectives and preliminary results of microstructural analysis obtained from Xray micro-tomography are presented, that complement the thermophysical methods and should offers the visualisation of the structural changes at least at the micron scale.