Microwave heating in materials science and biology: is it all just hype and hypochondria?

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Microwave heating is becoming increasingly important as a method of driving chemical synthesis and materials processes, both in solution, and in the solid state. There are also increasing concerns about the possible harmful effect that such radiation – as used in mobile 'phones - may have on biological tissue, over and above what might be expected from consideration of the likely heating effects at low exposure level. However, both aspects of this field are served by almost no direct experimental measurements of the nature of such effects and in many respects the microwave oven is treated merely as a 'black box'. We have developed several different types of microwave reactor that enable us to study how the structure and composition of materials change during microwave irradiation by *in situ* X-ray or neutron scattering measurements on powders, single crystals, colloidal and liquid crystal systems. We are also able to measure temperature accurately and precisely throughout such processes. This equipment has been used follow materials synthesis in solution and in the solid-state, revealing phase-selective temperatures and phase changes during microwave irradiation. It has also been used to probe the possible effect of microwave radiation on the structure of proteins and biological membranes through *in situ* small angle neutron scattering measurements.