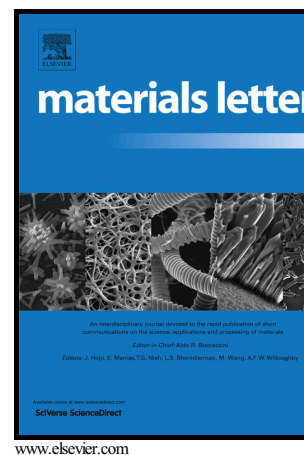


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## ***In situ* measurement of shrinkage and temperature profile in microwave- and conventionally-sintered hydroxyapatite bioceramic**

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### **Abstract**

The clear advantages of microwave (MW) sintering in terms of energy savings as well as superior mechanical properties have led to the popularity of this technique in recent years, especially in the bioceramics community. However to date, no study has established a systematic comparison between the sintering behavior of the most commonly used bioceramic, hydroxyapatite (HA), during MW and conventional sintering. Here, we utilize *in situ* dilatometry along with optical pyrometry to monitor the rate of shrinkage and temperature profile for various sintering conditions of HA. Temperature-dependent dielectric measurements indicate that microwave coupling occurs around 900 °C and the maximum linear shrinkage is reached, on average, 4 times faster in MW sintering. Finally we show that by tuning the MW power, one can effectively benefit from the non-linear increase in relative permittivity to exert control over the evolution of microstructures and hence achieve the desired combination of physical properties for personalized biomedical applications.

**Keywords:** Biomaterials; Metallurgy; Dielectrics; Sintering; Thermal analysis; Dilatometry

### **1. Introduction**

The dominant mode of heat transfer in primary stages of conventional sintering is convective and therefore temperature gradient in the sample can widely vary before the surface is sufficiently heated and thermal conduction takes over. In microwave (MW) sintering on the contrary, dielectric heating gives rise to a nearly uniform

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