MICROWAVE PROCESSING OF NEW GENERATION ELECTRONIC DEVICES

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ABSTRACT

Electroceramic devices such as varistors, capacitors, transducers and integrated devices constitute a billion-dollar global market owing to their applications in most modern electronic appliances. Each of these devices consists of a dielectric layer sandwiched between metal electrodes. The key step that determines the electrical properties of such a device is sintering, which converts the green component into a dense monolithic device. The conventional manufacturing procedures available for the fabrication of these devices involve tedious multi-step binder removal stages, long processing durations and high sintering temperatures. These cumbersome procedures lead to low equipment productivity, unwanted diffusion of electrode (eg., in most multilayer structures) into the ceramic, excessive grain growth (in the case of nanocrystalline varistors), ceramic inter-diffusion at the component interface (in the case of integrated devices) and in turn inferior electrical performance. This necessitates the need to look for alternate and improved processing methodologies.

In the present work, the feasibility of employing the microwave methodology for the processing of integrated passive devices, nanocrystalline ZnO radials and nano multilayer devices was explored. Methodical microwave sintering experiments were carried out using a multimode, 2.45 GHz microwave applicator. Effect of various experimental parameters such as heating rate, cooling rate, soaking time, sintering temperature etc. on the processing of these device components was investigated in detail. The resultant products were characterised for microstructure, composition and electrical performance. The various stages involved in taking the laboratory research to industrial scale-up production was also examined. The technique seems to be attractive in terms of its simplicity, rapidity, economic viability and the superior product performance achieved in all the cases augers well for its general applicability.