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Microwave processing of dielectric ceramics and effect of nanoparticles as sintering aids

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Densification of electronic ceramics with minimum porosity is an important requirement for applications involving dielectrics, ferroelectrics and piezoelectrics. Often properties depend on the grain size itself while the porosity would degrade the quality of the ceramics. Achieving good density at lower temperatures and in short duration is the challenge. The methods that are found to solve these problems include usage of nanoparticles of the material as its own sintering and using microwave power either at the calcination stage or sintering stage or both. In many cases, atleast in one stage conventional processing has given better results. How the microwave processing results in different microstructures, faster sintering process and evolution of newer material phases is interesting. The way the microwave furnaces can be used for such purposes in different modes is also an important aspect. The electromagnetic field configuration inside the furnace chamber, role of additional structures that are to be used inside the microwave furnace like susceptor and insulations also need to be taken into account. The presentation would cover these topics including a tutorial on microwave processing and the phenomena involved. The material systems covered includes ferroelectric BaTiO_3 , thermoelectric SrTiO_3 , high temperature piezoelectric $\text{SrBi}_4\text{Ti}_4\text{O}_{15}$, low loss dielectrics like $(\text{Zr},\text{Sn})\text{TiO}_4$ and $\text{Ba}(\text{Zn}_{1/3}\text{Ta}_{2/3})\text{O}_3$. In some cases new types of ordering were discovered in these materials by microwave processing. But the fast processing given by microwave method gives its own problems when it comes to ordering and grain growth and they will be discussed. Usage of nanoparticles of the same materials as sintering aid is another topic that will be introduced.

Biography

K C James Raju did his PhD in microwave materials and measurement techniques from Indian Institute of Technology, Chennai in 1996 and joined University of Hyderabad. His work is on low loss microwave materials, ferroelectrics, high temperature piezoelectrics and microwave processing of materials. For various device developments, he make these materials as thin film films for which he uses techniques like sol-gel processing, RF sputtering, pulsed laser deposition and laser annealing. He works on developing characterization techniques for materials and thin films in the microwave frequency range. Using simulation software's, he studies the microwave test structures. For bulk material processing, he uses microwave assisted processing with good success even for low loss materials and found interesting results. The usage of nano particles of a particular material as sintering aid for sintering of the same composition is another area of his interest. He currently works on ways to reducing the processing temperatures of materials and thin films.

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