Nanocomposites and nanomaterials

Study of sintering kinetics of multilayer ceramic capacitors based on the $BaTiO_3$ nanopowder.

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The continuous development of new, smaller electronic devices with improved properties is the trend of miniaturization their components.

The further miniaturization of MLCC is possible by reducing the thickness of the dielectric layer less than 1 mμ while the simultaneous increasing of dielectric layers number [1]. The most widely used dielectric matrix for MLCC is $BaTiO_3$ due to its extremely high dielectric constant. In order to obtain the thickness of the dielectric layers about a few hundred nanometers, the $BaTiO_3$ grain size should be 40-45 nm, i.e. close to ferroelectric - paraelectric switch, and the size of nanoparticles constituting - 10-15 nm.

To obtain the necessary electromagnetic characteristics of capacitors and to prevent a problem associated with consolidation of $BaTiO_3$, the controlled sintering in reductive-oxidative gas environment was used.

The sintering was conducted in two stages. The aim of the first stage of the two-phase sintering is obtaining of a homogeneous microstructure of pores while minimizing the grain growth. The second stage is a hold at a specific temperature. During this stage, the occlusion of pores takes place. Still, there is the problem of unwanted stress on the boundaries of layers insulator- conductor due to the difference of shrinkages of two these diverse materials. This problem should be solved by optimizing the sintering process. Namely through the equalization speed of shrinkages of this materials by adjusting the rate of heating and sintering time.

1. *Abhijit Gurav, Craig Scruggs, Richard Turner and Travis Ashburn*. Consideration for base-metal electrode (BME) ceramic capacitors for high reliability applications // CARTS international, Houston, Texas, USA, 2013.- **9**.-P.