

Nanocomposites and nanomaterials

Tape Casting of ferroelectric thin films based on BaTiO₃ nanopowders. Effect of components on the rheology of suspensions for casting and properties of the films.

S.E. Ivanchenko, I.O. Dulina, S.O. Umerova, A.G. Nikulin, A.V. Ragulya

Frantsevich Institute for Problems of Materials Science of NASU, Krzhyzhanovsky St., 3, Kyiv-03142, Ukraine

E-Mail: sergonische@ukr.net

Reducing the size of microelectronic objects always was an important goal. Reducing the size and increasing of the capacity of multilayer ceramic capacitors can be achieved by reducing the thickness of its dielectric layers.

Suitable composite ferroelectrics tapes can be obtained by tape casting method using nanopowders of BaTiO₃.

Application of the nanoscale powders causes significant differences in the nature of flow and viscosity of the suspensions for tape casting, due to their high specific surface and activity. Therefore, for the preparation of a suspension we cannot use the classic compound formulation [1], so it's necessary to create and explore new systems. Use of nanopowders will reduce the thickness and roughness of the composite ferroelectrics tapes as well as improve its mechanical properties.

Suspension for tape casting consists of the following components: solid phase in powder form which determinate the main features of the film, the polymer which will form a matrix for solid phase distribution, plasticizer, which will provide required flexibility to the polymer matrix and solvent required for the preparation of the polymer and plasticizer solutions, which is also uses for wet milling of powder.

As solid phase was used BaTiO₃ powder with mean particle size of 20 – 25 nm, ethanol, butanol, and the azeotropic mixture of low polar solvents was used as the solvents. Polyvinyl buteral with molecular weights from 40 000 to 75 000 was used as a polymer binder and dibutyl phthalate as a plasticizer.

The influence of the type and quantity of individual components of the suspension of its rheological properties, and the influence of the suspension rheology and composition on the thickness, roughness and the uniformity of the films was established. These studies will allow us to obtain films with predetermined characteristics for applications in microelectronics.

I. Mistler, R. E. and Twiname, E. R. Tape Casting: Theory and Practice. The American Ceramic Society, 735 Ceramic Place, Westerville, Ohio 43081, 2000.-298.-P. 240-255.