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Template-less Self-Assembled Morphologically Cubic $BiFeO_3$ for Improved Electrical Properties

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Abstract : Ceramic capacitor technologies using lead based materials is being phased out for its environmental and handling hazards. Bismuth ferrite ($BiFeO_3$) is the next best replacement for those lead-based technologies. Unfortunately, the electrical properties in bismuth systems are not as robust as the lead alternatives. The improvement of electrical properties such as charge density, charge anisotropy, relative permittivity, and dielectric loss are the parameters that will make $BiFeO_3$ a competitive alternative to lead-based ceramic materials. In order to maximize the utility of these properties, we propose the ordering and an evaporation-induced self-assembly of a cubic morphology powder. Evaporation-induced self-assembly is a template-less, bottom-up, self-assembly option. The capillary forces move the particles closer together when the solvent evaporates, promoting organized agglomeration at the particle faces. The assembly of particles into organized structures can lead to enhanced properties compared to unorganized structures or single particles themselves. The interactions between the particles can be controlled based on the long-range order in the organized structure. The cubic particle morphology is produced through a hydrothermal synthesis with changes in the concentration of potassium hydroxide, which changes the morphology of the powder. Once the assembly materializes, the powder is fabricated into workable substrates for electrical testing after consolidation.

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