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Oriented hexagonal ferrite thin films prepared by chemical solution deposition

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Hexagonal ferrites (M, Y, Z-type) represent a new diverse class of magnetoelectric (ME) multiferroics, where ME effect is driven by complex magnetic order. Integration of ME materials with standard semiconductor technology is important for ultimate realization of ME functionalities. They have the potential to display ME coupling under low magnetic field bias and at temperatures close to room temperature. Methods based on sol–gel transition offer possibility of low cost and efficient way for the evaluation of new material system. The single phase, epitaxial thin films of Y-type hexagonal ferrite has been prepared and studied. Thin films of $Ba_2Zn_2Fe_{12}O_{22}$ (Y) hexaferrite were prepared through the chemical solution deposition method on $SrTiO_3$(111)(ST) single crystal substrates using epitaxial $SrFe_{12}O_{19}$ (M) hexaferrite thin layer as a seed template layer. The process of crystallization was mainly investigated by means of X-ray diffraction and atomic force microscopy. A detailed inspection revealed that growth of seed layer starts through the break-up of initially continuous film into high density of well-oriented isolated grains with expressive shape anisotropy and hexagonal habit.The vital parameters of the seed layer, i.e. thickness, substrate coverage,crystallization conditions and temperature ramp were optimized with the aim to obtain epitaxially crystallized Y phase. By overcoating this seed layer, Y phase prepared under optimum deposition and heat treatment conditions presents a (001) orientation perpendicular to the substrate. Perfect parallel in-plane alignment of the hexagonal cells of $SrTiO_3$ substrate and both hexaferrite phases was proved by fast ω and ϕ scan measurements on sets of several diffraction planes at asymmetric orientations, and also by pole figures. The soft magnetic character and existence of pronounced magnetic anisotropy in Y films were confirmed by room temperature measurements of magnetization.

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