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ABSTRACT

A novel method to fabricate free-standing hemispherical shells of multilayer thin film is the demand of future technology to enhance the superlattices and multiferroic materials with one-dimensional quantum confinement. This is the first report to describe the fabrication of multilayer ($LaNiO_3$ (LNO) (top electrode)/$Pb(Zr,Ti)O_3$ (PZT)/LNO (bottom electrode)) free-standing thin film with a close-packed hemispherical shell structure. The cross-sectional investigations of the single hemispherical shell reveal the hemispherical space inside the multilayer thin film which is indeed to alleviate the clamping force from the substrate and also it represents each layer in this film has uniform thickness though it is troublesome to achieve in the case of hemispherical shell structure is noteworthy. The fabricated device made up of a thin PZT film sandwiched between the two electrodes with hemispherical close-packed structure (CPS) is the most conceivable material that would open a new window of the wide variety of applications.

1. Introduction

A recent scenario on the large-scale self-assembly of two-dimensional (2D) ordered array of meso-, micro-, and nanostructured building components are most suitable material for the design and device fabrication.[1-23] Different kind of structure was formed with monolayer colloidal crystals (MCCs) as a template.[1-23] There is some frontier work explains the formation of a different kind of arrayed 2D nanostructure using MCCs as a template. Li *et al.* and Cai*et al.*[8] used polystyrene (PS) MCCs to fabricate the ordered micro/nanostructured arrays. Piwonski*et al.*[16] have reported, the preparation of polymethyl methacrylate (PMMA) template to fabricate macroporoustitania coatings. Chen *et al.*[17] fabricated large area nickel nanobump arrays based on a PS monolayer film. Zhang *et al.*[24] prepared magnetic multilayer nanobowl array by using monolayer of PS as a template. 2D ordered nanostructure plays the pre-eminent role in photonic crystals,[1] surface self-cleaning materials,[2,3] and biosensors.[4] Beyond well-established methods for the fabrication of close-packed structure (CPS), there is an increasing import for alternative and inexpensive techniques in order to make the processing very simple and economical. Nanosphere lithography (NSL) is a precise method for the fabrication of periodic arrays of nanometer-scale particles which also provides outstanding control of nanoparticle size, shape,