In-situ growth of $Ge_2Sb_2Te_5$ nanoparticles grown by pulsed laser deposition and their phase-change electrical characteristics for memory applications

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Abstract

Phase change Ge-Sb-Te (GST) nanoparticles have been *in-situ* synthesized by a pulsed laser ablation method [1]. Energy dispersive x-ray analysis is performed to look into chemical composition of the GST nanoparticles. Scanning and transmission electron microscopy are used to image local structure and phase formation of the nanoparticles. Fourier transformed analysis of the electron microscopic images shows a face centered cubic structure with the $Ge_2Sb_2Te_5$ phase and it is confirmed that lattice parameter of $Ge_2Sb_2Te_5$ nanoparticles is about 6 Å which is in good agreement with the bulk value. The local structure of GST nanoparticles has been examined by extended x-ray absorption fine structure spectroscopy. Distance of Ge atoms in nearest and next-nearest neighbors is carefully analyzed and compared with others' results. Effect nitrogen doping into GST nanoparticles is briefly discussed. Current-voltage characteristics of the GST nanoparticles are examined in a metal-dot capacitor structure to see phase-dependent resistance effects. This measurement suggests a potential application for high density phase-change random access memories with low writing current.

[1] H. R. Yoon, W. Jo, E. H. Lee, J. H. Lee, M. Kim, K. Y. Lee, and Y. Khang, “Generation of phase-change Ge-Sb-Te nanoparticles by pulsed laser ablation”, Journal of Non-crystalline Solids **351**, 3430 (2005).