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Transparent Nano-floating Gate Memory Using Self-Assembled Bismuth Nanocrystals in $Bi_2Mg_{2/3}Nb_{4/3}O_7$ (BMN) Pyrochlore Thin Films

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The nano-sized quantum structure has been an attractive candidate for investigations of the fundamental physical properties and potential applications of next-generation electronic devices. Metal nano-particles form deep quantum wells between control and tunnel oxides due to a difference in work functions. The charge storage capacity of nanoparticles has led to their use in the development of nano-floating gate memory (NFGM) devices. When compared with conventional floating gate memory devices, NFGM devices offer a number of advantages that have attracted a great deal of attention: a greater inherent scalability, better endurance, a faster write/erase speed, and more processes that are compatible with conventional silicon processes. To improve the performance of NFGM, metal nanocrystals such as Au, Ag, Ni Pt, and W have been proposed due to superior density, a strong coupling with the conduction channel, a wide range of work function selectivity, and a small energy perturbation. In the present study, bismuth metal nanocrystals were self-assembled within high-k $Bi_2Mg_{2/3}Nb_{4/3}O_7$ (BMN) films grown at room temperature in Ar ambient via radio-frequency magnetron sputtering. The work function of the bismuth metal nanocrystals (4.34 eV) was important for nanocrystal-based nonvolatile memory (NVM) applications. If transparent NFGM devices can be integrated with transparent solar cells, non-volatile memory fields will open a new platform for flexible electron devices.

Keywords: NFGM device, Bi-Nanocrystals, Pyrochlore thin films, Nonvolatile memory

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Transparent Capacitor of the $Bi_2Mg_{2/3}Nb_{4/3}O_7$(BMNO)-Bi Nanostructured Thin Films grown at Room Temperature

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BMNO dielectric materials with a pyrochlore structure have been chosen and they have quite high dielectric constants about 210 for the bulk material. In the case of thin films, 200-nm-thick BMNO films deposited at room temperature showed a low leakage current density of about 10^{-8} A/cm^2 at 3 V and a dielectric constant of about 45 at 100 kHz. Because high dielectric constant BMNO thin films kept an amorphous phase at a high temperature above 900^{o}C. High dielectric constant BMNO thin films grown at room temperature have many applications for flexible electronic devices. However, because the dielectric constant of the BMNO films deposited at room temperature is still low, percolative BMNO films (i.e., those were grown in a pure argon atmosphere) sandwiched between ultra-thin BMNO films grown in an oxygen and argon mixture have greater dielectric constants than standard BMNO films. However, they still showed a leakage problem at a high voltage application. Accordingly, a new nano-structure that uses BMNO was required to construct the films with a dielectric constant higher than that of its bulk material. The fundamental reason that the BMNO-Bi nano-composite films grown by RF-Sputtering deposition had a dielectric constant higher than that of the bulk material was addressed in the present study. Also we used the graphene as bottom electrode instead of the Cu bottom electrode. At first, we got the high leakage current density value relatively. but through this experiment, we could get improved leakage current density value.

Keywords: BMNO, Capacitor, Graphene, Nano-composite, Rf-sputtering