Electric Property of Novel Ferroelectric Thin Film Based on PZT

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We have succeeded in fabricating $Pb(ZrTiNb)O_3$ (PZTN) thin films with more than 10 at % Nb, which is suitable for high density and reliable ferroelectric random access memory (FeRAM) applications. A sol-gel spin-coating method was used to prepare the PZTN thin films. 1 to 3 at % Si co-doping was applied to promote the solid-solution of Nb atom into the original $Pb(ZrTi)O_3$ films. Obtained 150-nm-thick $PbZr_{0.2}Ti_{0.6}Nb_{0.2}O_3$ film has very low leakage current and realizes excellent imprint and data-retention properties. XRD reciprocal space mapping and Raman scattering reveal that our PZTN film is a single ferroelectric phase of ABO_3 perovskite-type structure and Nb substitutes B-site atom. In addition, we suggest that in our PZTN, the oxygen vacancies are effectively suppressed due to the Nb substitution, in contrast to conventional $Pb(Zr,Ti)O_3$ (PZT). The first-principle calculation indicates that this reduction of the oxygen vacancy remains bandgap wide enough and hence reduces the leakage current in our PZTN film.