Supporting information

Lead-free $AgNbO_3$ anti-ferroelectric ceramics with enhanced energy storage performance by MnO_2 modification

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Experiment

$AgNbO_3$ and MnO_2-doped $AgNbO_3$ ceramics (abbreviated as ANM_x, x is 0, 0.1, 0.2, 0.3, 0.5, 1.0, 2.0 and 5.0wt%, respectively) were prepared by conventional solid-state reaction method using Ag_2O (≥99.7%), Nb_2O_5 (≥99.99%) and MnO_2 (≥97.5%) as the raw materials. These oxide powders were mixed by using a planetary ball mill with anhydrous ethanol at 250rpm for 24h, in a nylon jar with zirconia ball media. The dried powder mixture was pressed into disks with 20mm in diameter and 2mm in thickness and calcined at 980 °C for 6 h in O_2 atmosphere. The calcined powders were milled again and pressed into disks of 8mm in diameter and 1.2mm in thickness, followed by cold isostatic pressing under 220 MPa for 1.5 min. The green pellets were sintered at 1070-1090 °C for 6 h in O_2 atmosphere to prevent the possible decomposition of the silver oxide at high temperature. The density of the sintered pellets was determined by the Archimedes method. X-ray diffractometer (XRD, D8 Advance A25, Bruker, Germany) with monochromatic Cu K_α radiation (λ=1.5405 Å) was used to determine the phase structure. The microstructure of the sintered samples was examined by field emission scanning electron microscopy (FE-SEM, Merlin VP compact Zeiss, Germany). The pellets were polished down to a thickness of 220 μm and coated with Ag electrode at 600°C/0.5h for high electric field measurements. The hysteresis loops were measured in silicone oil with a ferroelectric measurement system of an aixACC TF Analyzer 1000 at 1 Hz (aixACCT TF Analyzer 1000, Germany).

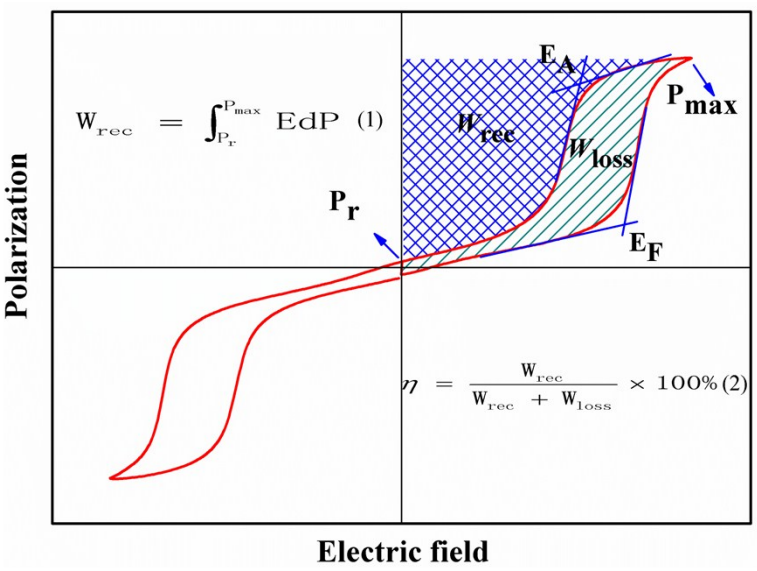

Fig. S1. Schematic diagram for the calculation of energy storage properties of AFE materials.

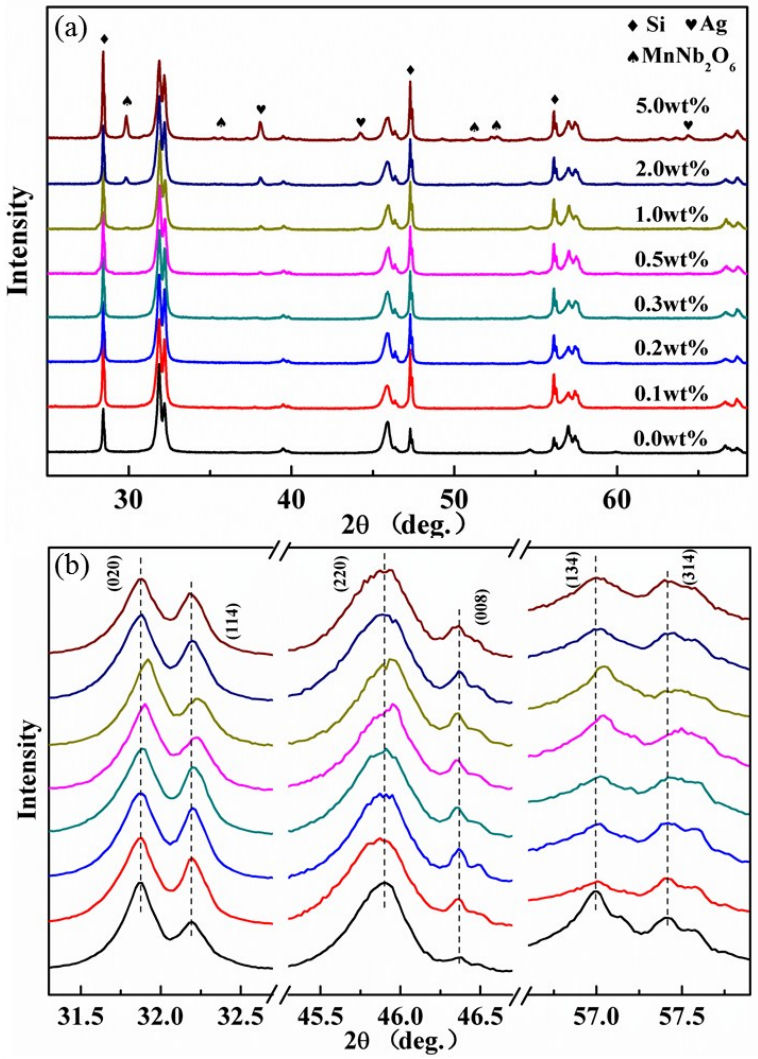

Fig.S2. XRD patterns of pure $AgNbO_3$ and Mn-doped $AgNbO_3$ ceramics.

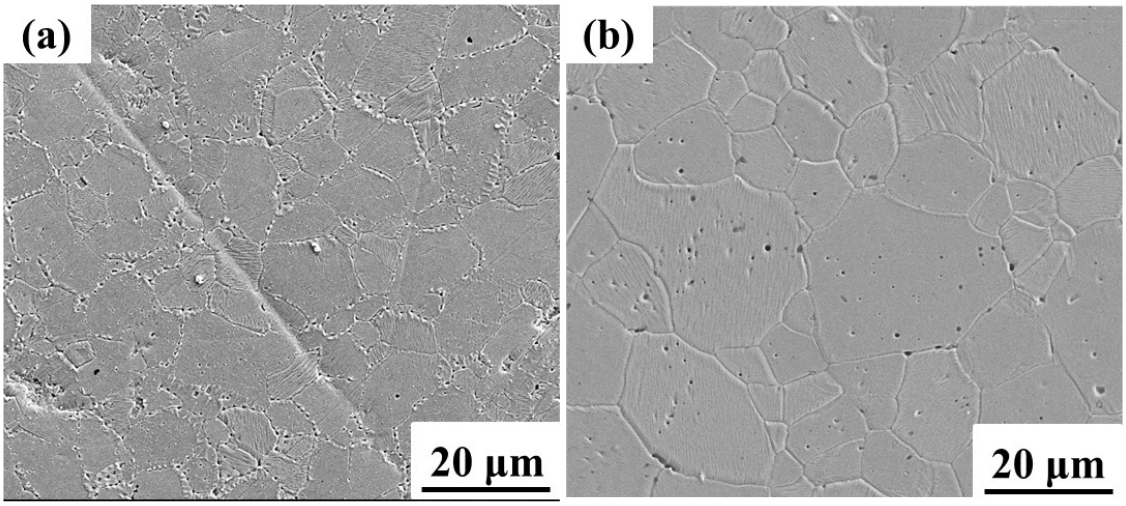

Fig.S3. SEM of pure $AgNbO_3$ (a) and 0.3wt%Mn-doped $AgNbO_3$ (b) ceramics.