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Ferroelectric Transitions in Silver Niobate Ceramics

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$AgNbO_3$ ceramic samples were prepared using conventional solid-state reaction methods with sintering under flowing oxygen. Stoichiometric amounts of Ag_2O (99.7%,) and Nb_2O_5 (99.99%, Sinopharm Chemical Reagent, China) powders were ball-milled in ethanol for 12 h using a planetary ball mill (QM-3SP4, Nanjing University Instrument, China). After drying, the mixtures were calcined at 850 °C for 6 h, using a pipe furnace (GLS-1700X, Hefei Kejing, China), in flowing oxygen at a rate of 500mL/min. The calcined powders were milled in ethanol for 4 h and after drying, the powders were mixed with 5 wt% polyvinyl alcohol (PVA) solution and then pressed into pellets with a diameter of 10 mm and *ca*. 1 mm thickness under 200 MPa

uniaxial pressure. The pellets were heated at a rate of 5 °C/min to 600 °C and held at this temperature for 2 h to burn off the PVA. The samples were subsequently sintered from 1000 to 1140 °C in oxygen at a flow rate of 500mL/min for 6 h, followed by cooling to 500^{o}C at a rate 5 °C/min. After that, the samples were cooled down to ambient temperature followed by furnace. The ceramic with highest relative density ~97%(Archimedes method) was obtained at the sintered temperature of 1090^{o}C [see Fig.S1]. The backscatter electron image and EDS elements mapping of the 1090^{o}C sintered ceramic surface clearly reveals that the ceramic shows uniform chemical distribution and no impurity or second phase can be found, indicating that the ceramic is single phase. But after thermal etching at 975^{o}C in air, the Ag deficient could be found in some area. The ceramic surface was observed by scanning electron microscopy (SEM, Quanta FEG 250, FEI, Hillsboro, USA), equipped with backscatter electron detector and Electronic differential system (EDS).

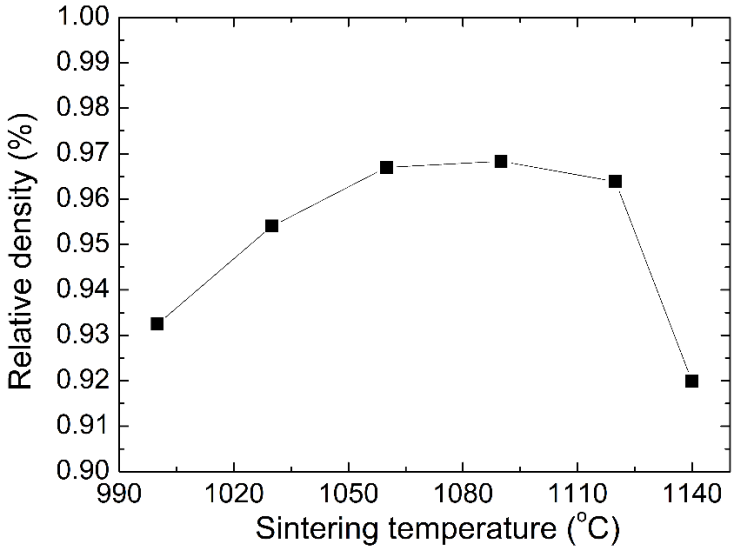

Fig.S1 Relative density vs. sintering temperature

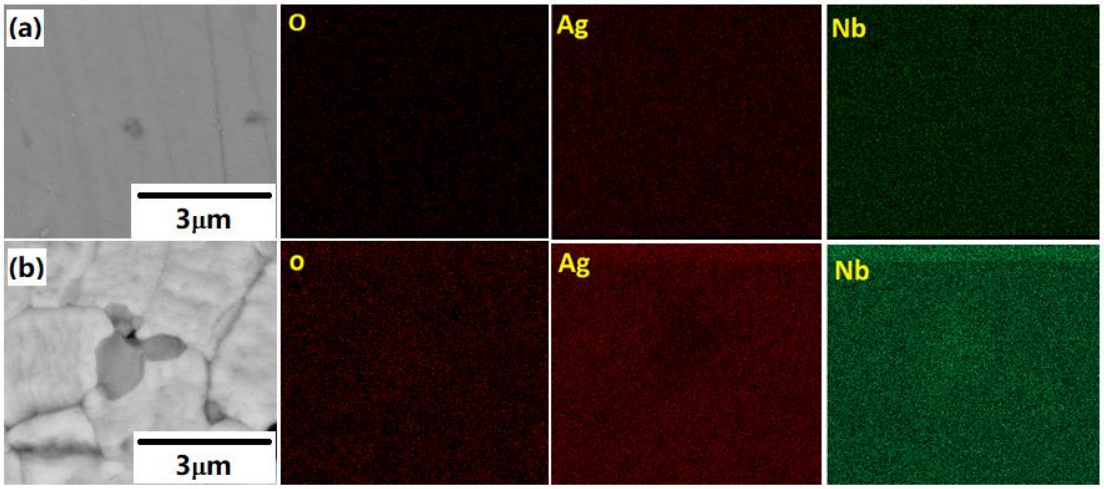

Fig.S2 SEM image (backscatter electron) and elements mapping of (a) polished ceramic surface (b) etched ceramic surface

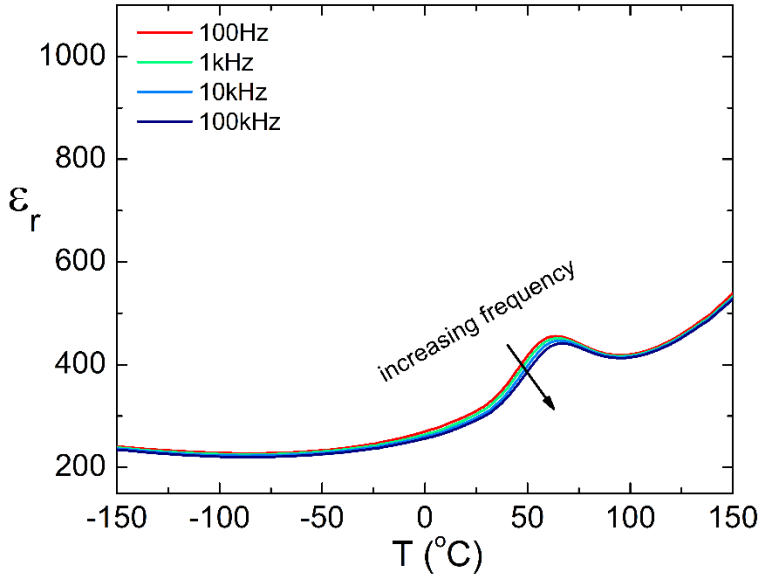

Fig.S3 Temperature-dependent relative dielectric permittivity measured from -150 to 150°C.

Table SI Refinement parameters of $AgNbO_3$ ceramic at 25ºC using non-polar *Pbcm* and polar $Pb2_1m$ space groups, respectively.

Chemical formula	$AgNbO_3$	
Formula weight	266.38	
Crystal system	Orthorhombic	
Space group	*Pbcm*	$Pb2_1m$
Unit cell dimensions(Å)	a = 5.55745(8)	a = 5.54782(2)
	b = 5.61546(2)	b = 5.60583(4)
	c = 15.68707(4)	c = 15.66004(6)
volume($Å^3$)	489.557	487.030
Z	8	8
Density(calculated)(g/cm^3)	6.750	6.786
R-factors	R_{wp} = 0.0929	R_{wp} =0.0916
	R_p = 0.0652	R_p = 0.0645
	R_{exp} = 0.0537	R_{exp} = 0.0537
	R_F^2 = 0.0795	R_F^2 = 0.0758
Total No. of variables	42	58
No. of profile points used	4231	4231