DEPOSITION OF NICKEL STRONTIUM AND NIOBIUM DOPED PZT THIN FILMS BY RF MAGNETRON SPUTTERING

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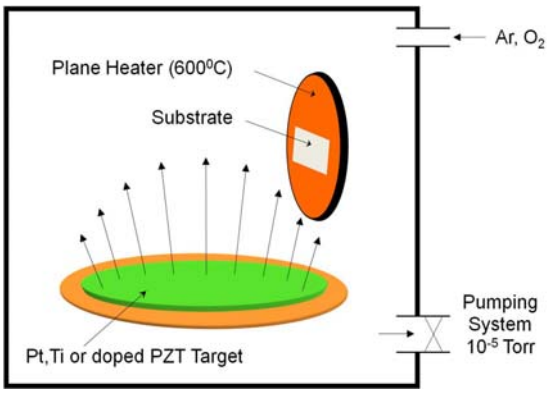
Objectives

- Synthesis and characterizarion of nikel, strontium and niobium doped PZT ceramic materials.
- Grown of doped PZT thin films with chemical composition $(Pb_{0.98}Sr_{0.02})(Ni_{0.06}Nb_{0.05}Zr_{0.49}Ti_{0.40})O_3$ by RF sputtering method.
- Structural, morfological and electrical characterization of doped PZT thin films.

Target preparation

Mixing 3h in a planetary ball mill using balls of 10 mm diameter and a ball/powder weighted ratio of 2/1. Dried and double calcined at 850^{0}C and 900^{0}C respectively with an intermediate milling of 1 h and a final wet milling of 10 h. Powders were compacted as discs of 55 mm diameter and 7 mm thick. The pressed samples were sintered at 1150-1350^{0}C with a dwell time of 4 h. The sintered samples were processed as discs with 50 mm diameters and 5 mm thick.



Thin films preparation

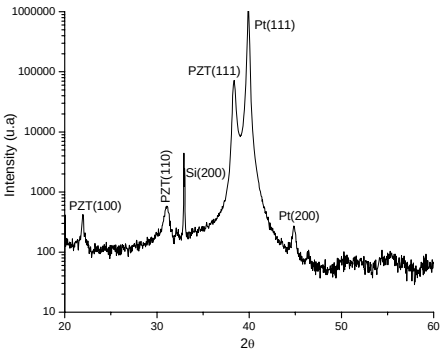
Thin films growth:

TiO_2(10nm)/Ti(2nm) adhesion structure deposited on SiO_2/Si substrate by reactive rf-magnetron sputtering at 10mTorr O_2 pressure, 600^{0}C substrate temperature, 50W

Pt thin films were deposited onto TiO_2/Ti/SiO_2/Si substrate at 30W, 12mTorr Ar pressure, 600^{0}C, 200nm.

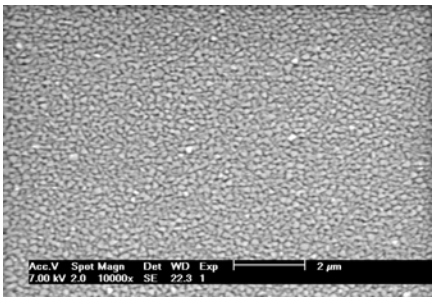
200nm doped PZT deposited by rf-magnetron sputtering, off-axis method, onto Pt/TiO_2/Ti/SiO_2/Si substrate at 100W, 15mTorr O_2 pressure, 600^{0}C substrate temperature

Characterization



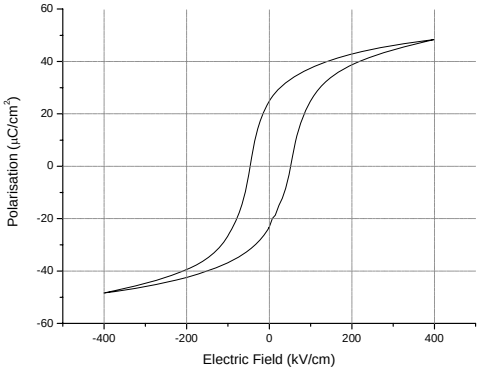
XRD spectra of oriented (111) PZT thin film deposited on TiO_2/Pt/TiO_2/Ti/SiO_2/Si substrate

The patterns show the perovskite structure. Few nanometer thick of TiO_2 layer represents a very efficient seed layer for the nucleation of doped PZT(111)



Scanning electron microscopy (SEM) of as deposited PZT thin film

The film clearly exhibit dense microstructures with relatively fine grains. The average grain size is typically 100 nm.



The polarisation versus electric field (P-E) hysteresis loop

- dielectric constant = 720
- dielectric loss = 0.03
- remnant polarization = 22μC/cm^2
- coercive field = 48kV/cm.

Conclusions

- Pt grown on TiO_2/Ti/SiO_2/Si substrate grow almost perfectly in (111) orientation (98 % texture index).
- PZT films deposited by RF sputtering method on Pt(111) by means of a 2nm thick TiO_2 seed layer show a preferred (111) orientation
- Doped PZT films show good electrical properties: dielectric constant = 720, Pr= 22μC/cm^2, coercive field = 48kV/cm

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