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## Chapter 2

### Aims and Objectives of Present Work

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Aim and objective of the present investigation is to firstly enhance the dielectric constant of CCTO by various dopants such as La, Nb, Sn, Zr on suitable sites and then to disperse these ceramics in the PVDF matrix to achieve high dielectric permittivity of polymer ceramic composite at a low content of ceramic, without affecting the mechanical strength and avoiding the above mentioned problems. The fabrication and characterization of these composite specimens is carried out as described below:

#### *Synthesis of Ceramic and Composites:*

- To prepare high dielectric permittivity  $\text{CaCu}_3\text{Ti}_4\text{O}_{12}$  and La, Nb, Sn, Zr doped  $\text{CaCu}_3\text{Ti}_4\text{O}_{12}$  by solid state method.
- Preparation of CCTO and La, Nb, Sn, Zr doped CCTO dispersed PVDF composites by extrusion method.
- Films of these composites were made using compression molding machine at  $200^\circ\text{C}$  under a load of 5 tons. Thickness of these films was kept approximately  $100\ \mu\text{m}$ .

#### *Characterizations:*

- **Phase analysis:** For phase analysis X-ray diffraction (XRD) patterns were recorded using Rigaku Desktop Miniflex II X-Ray diffractometer employing  $\text{Cu-K}\alpha$  radiation (wavelength,  $\lambda = 1.5418\ \text{\AA}$ ) and Ni-filter. Films of PVDF and composites were scanned in the  $2\theta$  angle range  $10 - 90^\circ$  at a  $3^\circ/\text{min}$ .

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- **Microstructure:** To study the microstructure of the composites SEM images were recorded using INSPECT S 50 FP 2017/12 Scanning Electron Microscope. Samples were coated with gold to make surface conducting.
  - **Thermal analysis:** To study the thermal behavior and stability of the composites Thermogravimetric analysis (TGA) of PVDF and its composites was done from 30 to 700°C at a heating rate of 10°C/min in air using Perkin-Elmer, USA TGA/DTA Analyser.
  - **Mechanical Properties:** To study the mechanical behavior of the composites tensile tests were performed on the microinjected dog bone shaped samples at room temperature using Instron 3369 Tensile Machine. A constant crosshead speed of 5 mm/min was selected and the stress–strain data were recorded till the samples broke. Three samples of each composition were tested.
  - **Dielectric measurements:** Dielectric measurements were performed on the disc-shaped films having 12 mm diameter. These were silver coated on the opposite faces and measurements were made between  $10^{-2}$  -  $10^6$  Hz using two probe Novocontrol set up (ZG4) from room temperature 40°C to 120°C.
  - **H-N function:** Temperature-dependent dielectric relaxation has been explained by Havriliak-Negami (H-N) function using Win fit software.