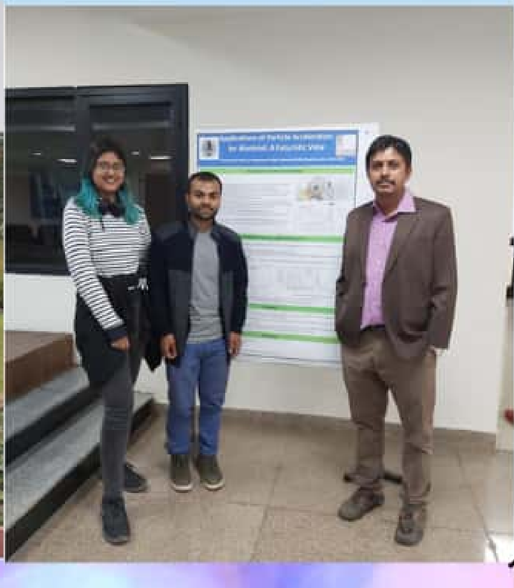
As a part of the visit, the students also visited the experimental setups witnessing the actual procedures followed to carry out experiments using the ion beams and accelerators. The large machines and instruments' working, although complicated, was briefed in a layman manner to the students to understand the basics of the concepts and processes.
The first visit was to the fusion/fission detector and the gamma ray detector. Although the systems were not operational, yet the guide explained about the working in a nutshell. As the beam strikes the foil target, the reactions take place and the detectors indicate the presence of the desired end products, if formed. Huge magnets used to deflect the path of the ions and the reaction products were also shown.
The second was the setup for the interaction of ion beam with the metal mass to study the interaction when the beam is made to fall on a metal kept in the chamber evacuated to about 10^(-6) orders of magnitude. Various proposed experiments on different ceramics are carried out there.

In the third lab, was placed a LINAC, Linear Accelerator. Although in unoperational mode, the instructor explained the very setup and working of it while the students listened curiously and patiently. The electric fields and potentials used to accelerate the charges also depended upon the length of the accelerator and are designed in such a way to equate the time taken by cover a length and force experienced in the path.
The final visit was to the control lab consisting of huge systems to electronically control the signals sent to such huge structures difficult to operate simultaneously, if done manually. The specialized systems also controlled the radiation absorption making the external human working area lesser exposed to harmful radiations.

Proper care was taken to ensure the safety of the students and it was made sure that the basics of all the working systems could be explained to much extent as possible.



AIM: to study the effect of two step sintering on the density and microstructure of BCZNT ceramics made from nanopowders.

-Dipankar Das
3rd Year

Abstract: BZT- BCT, a highly stable lead free piezoelectric ceramics system has gained importance in recent years after a major breakthrough, when Liu et al. reported a high d33 ~ 620 pC/N in BT based lead-free composition: 0.5 Ba(Ti0.8Zr0.2)O3- 0.5 (Ba0.7Ca0.3)TiO3 (BZT-BCT). They found a morphotropic phase boundary (MPB) starting from the tricritical triple point of paraelectric cubic phase, ferroelectric rhombohedral phase and ferroelectric tetragonal phase. Despite the high reported properties, BZT-BCT ceramics suffers major drawbacks of low Curie temperature and temperature-dependent MPB. In the subsequent studies, it had been revealed that the properties of polycrystalline ceramics are controlled by the microstructure. The density, grain size and presence of heterogeneities in the microstructure are carefully controlled to improve the properties and reliability of ceramics. Therefore, in the chronology of preparation, sintering is a critical step in the production of these creamics with high density. Recently, many advanced sintering methods have reported to fabricate ceramic materials with controlled properties. Two step sintering (TSS) is one of the simple and cost effective methods to obtain near theoretical density materials with controlled grain growth. Many recent works have reported the use of TSS as a processing method to fabricate nanoceramics for various applications. With this background, this work reviews the advantages of TSS (in ceramic preparation) on microstructure and hence on the properties of the material.

PLAN OF WORK

• Literature survey and background
1. Studying the relevant research papers on TSS(two step sintering).
2. Gaining knowledge on the concepts like grain size and density variation with TSS.

• Experiment
1. Synthesis of ceramics via solid-state reaction route– Calcination, high energy ball milling, Two-step sintering.
2. Material characterization: XRD analysis, TEM analysis, SEM ananlysis.
3. Electrical measurements: Dielectric measurements, ferroelctric measurements and piezoelectric measurements.

Deliverables

• Basic understanding of piezoelectric systems and their behavior with difefrent processing
parameters.
• Understanding the basic difference between conventional sintering and Two Step Sintering.
• An optimized sintering routine for maximum dense ceramics with high electrical properties.
• Understanding the direct influence of sintering parameters and hence the grain size on the
final bulk properties of the ceramic made form the nanopowders.