INCUBATION, RESEARCH AND DEVELOPMENT CELL (PROPOSAL: 01)

Title of Project Proposal: **Establishment of "Advanced Material Science Research Lab"**

Proposal Submitted to: Principal, NSCB Memorial Post Graduate College, Hamirpur

Proposal Submitted by: **Department of Physics. NSCBM, Govt PG College, Hamirpur**

Objectives: - Students will able to develop various **Ferrite based Magnetic Nanoparticles** for high frequency applications

Introduction

Ferrite-based magnetic nanoparticles have garnered significant interest across multiple scientific fields due to their distinctive characteristics derived from their nanoscale dimensions. The proposed project will enable the student to grow the magnetic nanopowders at nanoscale and to explore their potential applications in various emerging fields. Ferrites are an important class of magnetic materials having assorted technological applications; Ferrites have a high permeability and a very high electrical resistivity ranging from 10^2 ohm-cm to 10^{10} ohm- cm which is up to 15 orders of magnitudes higher than that of iron. It is these two properties along with ability to control magnetic losses by change in dopant concentration etc. which makes ferrites a highly useful technological material. Ideal ferrites cannot be obtained with all improved characteristic properties such that it is capable of covering a complete spectrum of applications. Therefore, a compromise has to be made in improving one characteristics property at the expense of the other property by substituting suitable ions in various ferrites. Properties of ferrites are highly sensitive to the type and amount of the impurity. In spinel ferrites, a number of workers have studied the effect of divalent, trivalent, tetravalent impurities Zn^{2+}, Mn^{2+}, Ni^{2+}) etc. provide a wide range of saturation magnetization and enhancement of resistivity in certain ferrites. The trivalent ions Al^{3+}, Cr^{3+}, $In3^{+}$ and Ga^{3+} etc modify certain other properties depending upon the nature of substituted ions. The modified properties of theses ferrites have been found to be particularly suitable for many technological applications. The substituted ions like Si^{4+}, Ti^{4+}, Ge^{4+} and Sn^{4+} have been

found to promote the coarse crystallization and grain growth.In hexagonal ferrites rare earth substitution may enhance the electrical and magnetic properties.

Objectives:-

1. This proposal submitted for establishment of a new lab entitled as "**Advanced Material Science** Research Lab" for UG/PG (Science) Courses by Department of Physics,so that our students get benefitted by indulging themselves in the emerging themselves in development of nanomaterial fabrication.
2. The UG/PG students involve themselves in **Major/Minor projects** in the field of material science.
3. This **Advanced Lab** will provide the facility for the students as well as faculty members in developing the new materials having variety of applications viz. *memory storage devices, radar technologies, satellite technologies as well as communication technologies.*
4. Create a variety of nanomaterials by employing the proper synthesis method, such as solution combustion techniques, the hydrothermal, Solgel auto-combustion technique and Solid-state reaction methods for synthesizing of different materials.
5. Use sophisticated analytical instruments, such as transmission electron microscopy (TEM), scanning electron microscopy (SEM), and X-ray diffraction (XRD), to characterize the produced nanomaterials.
6. To comprehend the essential qualities of the nanomaterials, look into their structural, morphological, and compositional aspects. Examine the manufactured nanomaterials' possible uses in energy storage, electronics, sensing, and catalysis.
7. The outcomes of this lab will fill the research gap at college level; teaching- learning process in comparison to universities level; teaching- learning process.

Pedagogy/Methodology: -

Synthesis: Choosing appropriate synthesis techniques according to the targeted qualities of the nanomaterial. To obtain the desired nanostructures, experiment with different precursor concentrations, reaction periods, and growth environments.

Characterization: methods such as AFM to examine surface properties, SEM and TEM to observe morphology, and XRD to ascertain crystal structures. Furthermore, methods such as energy-dispersive X-ray spectroscopy (EDX) can shed light on composition.

Analysis: To understand how fabrication conditions affect nanomaterial properties, correlate the collected characterization data with synthesis parameters.

Target Group: -

All the UG/PG (Med./Non-Med.) students of this college (500 Approx).

Budget allocation: About **Rs. 4,33,161** /- (*4 Lakhs Thirty-Three Thousand One Hundred and Sixty-One Rupees)* (Approx)

Conclusion

The students will able to contributes in advancing the nanomaterial research within the Department of Physics at College level. Enhances students' practical skills in nanomaterial fabrication and advanced characterization techniques. Opens entrepreneurships for collaborative research projects with industries and other academic institutions. Students will able to understand role of nanomaterial in emerging scenarios.

Yours sincerely,

(Dr. Virender Pratap Singh)
Asst. Prof of Physics
NSCB Memorial Post Graduate, College, Hamirpur (HP)

Principal
NSCB, PG College
Hamirpur