Indian Science Technology and Engineering facilities Map

(I-STEM)

Invites application for

1. **Partial financial support for using R&D facilities in other institutions through the I-STEM web portal to Users from Academic Institutions and Start-ups (Format-1)**

Format for requesting support for accessing and using facilities through the I-STEM web portal.

(i) Details of the Personal Information

a. Name of the Researcher/Faculty Member : Dr. Mandeep Singh
b. Name of Supervisor : Mandeep Singh
c. Name of the Institution/Start-up : Guru Nanak Dev University
d. Name of the Department :Physics
e. Degree registered for/Product being developed (for start-up)
f. Mob. No. 8968542572 g. Email ID: jmskhalsa@gmail.com

(ii) **Project/Research topic Details**:

a. Project Title/Research Title: **: Investigation of magnetic and μ-wave absorbing properties of $Sr_{1-x}Ca_xFe_{12}O_{19}$ and $Ba_{1-x}Ca_xFe_{12}O_{19}$ hexaferrite samples**

b. Sub area: Material synthesis and characterization

c. Area Description: magnetism and μ-wave absorption

Aims & Objective (in Bullets):

- Hexaferrite samples ($Sr_{1-x}Ca_xFe_{12}O_{19}$ and $Ba_{1-x}Ca_xFe_{12}O_{19}$) will be synthesized by calcining between 900 ºC- 1200 ºC.
- VSM and μ-wave equipments will be used to measure the structural, surface morphological and magnetic characteristics of these samples.
- The above-mentioned experimental data will be analyzed and interpreted.
- The information gathered will be compiled on a regular basis and published in suitable journals.

d. Duration (MM/YYYY): 2.0 Years

e. Project Summary (1000 words): Attached in the end
(Separate page may be attached to justify the requirements)

f. **Technical Details**

a. TRL
b. Methodology
c. Design & development
d. Facilities and Instrumentation required
e. Consumables (Scientific materials) :1.50 Lakh

g. **Expected output and outcome**

h. **Industry/Institute CollaborationIf, yes**

(i) Name of the Collaborating Industry/Institute
(ii) Collaboration Details
(iii) Additional Details if any

a. **Funding required from I-STEM (with justification:** Money is needed for purchase of raw materials (chemicals) for the research work.

Details of Requirements&Mode of the Engagement: (Attach the quotation for the consumables)

(i) Short term Engagement:

a. Usage of testing/characterization facilities across the country (Characterization Mode)
   i. Testing Charges
   ii. Consumable charges
   iii. Travel Cost (Boarding and Lodging, if any)

b. Usage of fabrication and testing facilities across the country (Fabrication Mode)
   i. Fabrication and testing Charges
   ii. Consumable charges (if any)
   iii. Travel Cost (Boarding and Lodging, if any)

(ii) Medium term Engagement:

a. Execution of project in any one of the Host Institution (Project Mode)
   a. Fabrication and or testing Charges
   b. Consumable charges (if any)
   c. Travel Cost (Boarding and Lodging, if any)

b. Execution of project in Multi Host Institutions (Project Mode)
   a. Fabrication and or testing Charges
   b. Consumable charges (if any)
   c. Travel Cost (Boarding and Lodging, if any)

(Round-trip to the Host Institution by 2nd class (Non-AC) railway via the nearest route)

Details of User's Bank Account:

(Please send a copy of the cancelled cheque/copy of the passbook carrying all the information needed)

Beneficiary Name (User's name): Mandeep Singh PAN: DEGPS6718A

Bank Account No. 55155188533 Name of the Branch: GNDU, Amritsar

IFSC Code: SBIN0051135

Note: Proposed proposal must be executed within stipulated duration (max. 6 month) to avoid fund availability issues. Travel form will be provided by the I-STEM office. The users will submit the technical report, original invoice (duly signed by the Head of the Institution) raised by the Host Institution through I-STEM portal only along with a copy of the travel forms and original tickets through post to the Nodal Officer, I-STEM, Indian Institute of Science, Bangalore. A scan copy of all the documents may be sent in advance.

Project Summary

Hexaferrites have remained significant in both science and technology since being discovered (in the 1950s). Based on the chemical composition and stacking along z-axis, they are classified into M, X, Y, W, Z and U –types. In comparison to all six types, M-type hexaferrites (having $MFe_{12}O_{19}$ as chemical formula) are easy to synthesize and have better magnetic properties. M-type hexagonal have magneto plumbite type structure. Barium (BaM) and Strontium hexaferrite (SrM) materials stand out among the others M-type hexaferrites for having excellent properties such as high saturation magnetization, good mechanical hardness, high uniaxial magneto crystalline anisotropy and corrosion resistance etc. Due to theses excellent properties, these materials are find applications in permanent magnets, magnetic recording media and electromagnetic μ-wave radiation absorbing coatings. A single M-type hexaferrite unit cell contains 64 ions ($24Fe^{3+}$, $2Ba^{2+}$ and 38 O^{2-}). The 24 Fe^{3+} ions are distributed across trigonal bi-pyramidal (2b), tetrahedral site (4f1) and octahedral sites (12k, 2a and 4f2) sites. The presence of 24 Fe^{3+}ions is mainly responsible for their magnetic characteristics. Their magnetic properties can be further improved by making appropriate substitution with various types of cations at the Ba (A-site) or Fe (B-site). Non-magnetic dopants (A-site and B-site) have been increasingly used to modify their magnetic properties. Non-magnetic metals such as Ca, Zn and Zr have already been used to modify their structural, magnetic and other properties either by themselves or in combination with a magnetic ion. The doping will not only lead to modification of magnetic characteristics of these samples but also their μ-wave absorption characteristics. Further, there is also a considerable amount of interest in newer and newer μ-wave absorbing materials. We therefore propose to synthesize and study physical properties (magnetic and μ-wave absorbing) properties of $Sr_{1-x}Ca_xFe_{12}O_{19}$ and $Ba_{1-x}Ca_xFe_{12}O_{19}$ samples. Solid state technique will be used for material synthesis.