

ASSESSMENT/EVALUATION REPORT OF MAJOR RESEARCH PROJECT

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UNIVERSITY GRANTS COMMISSION
BAHADUR SHAH ZAFAR MARG, NEW DELHI – 110 002

A: DETAILS OF PROJECT


1.	Title of the Project	Study of the correlation between structural and magnetic heterogeneity, and semiconductivity in Co rich region of $Fe_{3-x}Co_xO_4$ ferrites
2.	The total duration of the Project	3 years (2013-2016) and extended till 31/03/2017
3.	Project Status	Completed
4.	Subject	Physics
5.	UGC Reference No. & Date	No. F 42-804/2013 (SR) Date. 14/03/2013
6.	Grant Approved	Rs. 17, 21, 200/ (Rupees Seventeen Lakhs Twenty One Thousand Two Hundred only)


B: EVALUATION REPORT OF EXPERT MEMBERS

1.	Name of the Principal Investigator	Dr RABINDRA NATH BHOWMIK
2.	Designation	Assistant Professor
3.	Address of Principal Investigator	Department of Physics, Pondicherry University, R. Venkataraman Nagar, Kalapet, Pondicherry- 605 014
4.	Whether work is focused on the title of the sanctioned project	As per the objective of the proposal, significant work has been carried out on the proposed composition Co rich region of $Fe_{3-x}Co_xO_4$ ferrites. Additionally, PI has worked on two other compositions, $Li_{0.5}Mn_{0.5}Fe_2O_4$ and $Ni_{1.5}Fe_{1.5}O_4$ focused the primary study on the proposed objectives
5.	Whether original work is done	Yes
6.	Whether significant contribution made by the Principal Investigator	Yes, The proposed work is published in high impact Peer-reviewed Journal (12) and conferences (4).
7.	Whether proposed work has relevance to the society/scientific community	The work carried out under this proposal finds application in magnetic sensor and non-linear spintronic devices and quite important for the researcher working in the area of condensed Matter Physics and Material science.

8.	What type of contribution found in the final report: Theoretical/ Practical. If there are theoretical contribution given by the Principal Investigator. Whether real applications are given	PI has synthesized ceramic $Fe_{3-x}Co_xO_4$ ferrites and additionally $Li_{0.5}Mn_{0.5}Fe_2O_4$ and $Ni_{1.5}Fe_{1.5}O_4$ adopting the various method of synthesis like; mechanical alloying/milling, solid-state sintering, and chemical co-precipitation and carried out structural, transport and magnetic measurements. Sufficient theoretical explanations and data fittings are presented to justify the mechanism to their observations. The investigations of physical properties of the synthesized compositions in the proposed duration are quite significant and find application in the design of the magnetic sensor and non-linear spintronic devices.
9.	Whether theoretical contributions and their results and findings are published	Yes
10.	Whether results and findings are significant	Yes
11.	Whether the significant publications made by Principal Investigator in peer-reviewed journals	Yes (Point 6)
12.	The number of publications made by Principal Investigator in standard reputed journals	Yes
13.	Whether contributions made by Principal Investigator is sufficient	Yes. The field of research is quite wide and open to the researcher for further studies.
14.	Whether the findings and results of the sanctioned major research project are justifiable	The PI aimed to get new knowledge on the electrical and magnetic properties of the $Fe_{3-x}Co_xO_4$ ferrite series in the Co rich region and synthesis condition. PI prepared the samples and used the complex physical methods for characterization. All results are compared with the similar and explained in the frame of the confirmed theory.
15.	Whether completed project work meets the proposed objectives	<p>The completion report presents the published result of the investigation with analysis and formulation of the conclusions on the proposed samples. I would select as the most interesting results:</p> <p>The magnetic properties of $Co_{2.25}Fe_{0.75}O_4$ ferrite strongly depend on structural change associated with the variation of annealing temperature, time and atmosphere.</p> <p>Ferrimagnetic properties of the samples are affected by configuration and stabilization/ destabilization of the structural phase. The MS and coercivity in bi-phased/tri-phased samples are correlated to the Fe rich phase and Co rich phase of the spinel structure,</p>

		<p>respectively,</p> <p>The ferrimagnetic parameters can be tuned by controlling structural phase components, and distribution of magnetic and non-magnetic Co and Fe ions among A and B sites of the spinel structure in the process of air annealing of as-prepared ferrite material.</p> <p>The spinel ferrite ($\text{Co}_{2.25}\text{Fe}_{0.75}\text{O}_4$) split into Co rich and Fe rich phases for an 800 °C air annealed sample. The Co rich phase is transformed into CoO under vacuum annealing. All sample showed relatively softer ferromagnetic properties at all range of temperatures and exchange bias effect at low temperatures.</p>
16.	Give your brief comments on the overall work of the project	<p>PI works are well accepted by the scientific community and the proposed work has been published in high impact peer-reviewed Journals of National and International repute as well as presented in conferences.</p> <p>The following questions are asked out of my curiosity, however, doesn't decrease the common positive impression on the made research:</p> <p>In section 5.3, the explanation is presented on the effect of the presence of different charge state of Co and Fe due to variation in annealing temperature. A further explanation of the presence of different charge state of Co and Fe on the magnetic behaviour could give additional insight to the readers.</p> <p>Minor Correction: Page 22: Synthesis: The powder $\text{Co}_x\text{Fe}_{3-x}\text{O}_4$ ($x = 1.25, 1.50, 1.75, 2.0, \underline{2.25}$ (replace by 2.5)) . (page 42): Ms measured in ZFC mode has shown always less value in comparison to ZFC mode</p>
17.	Any specific comments	
18.	Indicate your overall assessment of the project: Poor/Good/Excellent	Excellent.
19.	Name & Address of Expert	<p>Dr Vijaylakshmi Dayal Professor and Head Department of Physics, Maharaja Institute of Technology Mysore Belawadi, SrirangapatnaTq, Mandya – 571477, Karnataka INDIA E-mail: drvldayal@gmail.com, hodphysics@mitmysore.in,</p>

Signature & Seal	 19/04/2021
Date & Place	19.04.2021 Mandya


22/07/2022
Dr. RABINDRA NATH BHOWMIK
Associate Professor
Department of Physics
Pondicherry University
Puducherry - 605 014


11/8/2022
DEAN (RESEARCH)
Pondicherry University
Puducherry - 605 014