Surya Sen Mahavidyalaya

Siliguri

ASSESSMENT PERIOD

2018-2019 TO 2022-2023

SUPPORTING ATTACHMENTS

CRITERION – 3

Key Indicator – 3.5 Collaboration

3.5.1 Number of function MoUs/linkages with institutions/industries in India and abroad for internship, on-the-job training, project work, student/faculty exchange and collaborative research during the last five years.

Content:

Proposal for collaborative work on
Multiferroicity in Transition Metal Oxyhalides

UGC-DAE Consortium for Scientific Research
(An Autonomous Institution of University Grants Commission, New Delhi)
Block-LB, Plot-8, Sector-III, Bidhan Nagar, Salt Lake, Kolkata-700098, West Bengal, India
Kolkata Centre

From: *Dr. Souvik Chatterjee*
Scientist-E

Dt.:- 09/02/2018

Dear Dr. Karmakar,

Thank you very much for your collaborative research proposal. The proposal is a well written one and interesting enough. I am glad to accept your proposal for collaborative work. During the course of this collaborative work you may use our instrumental facilities by applying through our facility XVHIRUP¶VRUP QR

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Proposal for collaborative work on

Multiferroicity in Transition Metal Oxyhalides

Origin of the proposal

Multiferroicity is a phenomenon in which two or more of the magnetic, electric, elastic ferroic orders coexist in a single material. Many materials also show coupling between them, defining them as magnetoelectric multiferroics [1]. These materials are of tremendous importance in applications such as high capacity memory devices with dual control (read/write of magnetic storage with electric field and read/write of electric storage with magnetic field) and compact electrically controlled spintronic devices. But the typical problem of mutual exclusiveness of ferroelectric and ferromagnetic order makes the situation grave [2–4]. So, lately the efforts are to couple any orders like antiferro, ferri or canted antiferro capable of producing polarization.

There is an intimate connection between spiral magnetic order (cycloidal order in particular) and magnetoelectric coupling [5]. The origin of spiral magnetic order is either competing magnetic interactions or a topological spin frustration that finds a low energy state in the spiral magnetic order. There are many, the so called spin induced multiferroic materials, that owe their existence to this phenomenon [6–19]. Hence, study of the magnetic structure of promising spiral order magnets is currently the thrust area of multiferroic research.

Recently, a novel work on Cu_2OCl_2 dictates a new class of spin induced multiferroic materials which are oxyhalides of a few transition metals, namely, Cu, Co, Ni and Mn [20]. Cu_2OCl_2, in particular, exhibits magnetoelectric coupling in a spiral magnetic order, hence the possibilities of magnetic frustrations and magnetoelectric coupling through incommensurate magnetism in the rest of the members of this family with the same crystallographic structure. Furthermore, these melanothallite structures are expected to show considerably high transition temperatures as in Cu_2OCl_2. Also, there are possibilities of engineering the transition temperature via doping both at the transition metal and halide sites.

Objective

The multiferroic properties of the materials $A_2O(Cl,Br)_2$ with A = Cu, Co, Ni and Mn will be studied with the objective of finding a material with transition near room temperature for feasible practical applications in memory and spintronic devices. To do this, the materials will be tuned through substitution at the transition metal and halide sites. The motive is also to study the mechanism of multiferroicity and magnetoelectric coupling in the materials for which detailed magnetic and dielectric properties will be studied.

Methodology

Initially, the materials $A_2O(Cl,Br)_2$ (with A = Cu, Co, Ni and Mn) and their substitutions will be prepared via solid state reaction techniques. These will then be characterized and structural properties will be studied by X-ray diffraction experiments. The magnetic properties will be studied by magnetic measurements in a SQUID magnetometer in the temperature range 2 – 300 K. Dielectric and magnetodielectric properties will be figured out using impedance spectroscopic measurements with an LCR meter and polarization measurements using an electrometer equipped at low temperatures in a high magnetic field PPMS (up to 14 T magnetic field).

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References

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[A Multi-stream Govt. Aided College & Recognised by UGC u/s 2(f) &12(b)]
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ISO 9001:2015

Date: 10.04.2019

Collaborative Research

A collaborative research was started on 09.02.18 with Dr. Souvik Chatterjee (Scientist E, Materials Science Division, UGC-DAE Consortium for Scientific Research, Kolkata Centre, Sector, III, LB-8 , Bidhan Nagar , Kolkata 700 106) upon discussion and submission of a probable research proposal. The activity includes a few visits to his laboratory and performing experimental research works in Solid State Physics such as sample preparation and characterization (structural, electrical and magnetic). A few pictures are attached below with instances of work being undertaken in the center.

Participants:

1. Dr. Arindam Karmakar, Assistant Professor, Physics, Surya Sen Mahavidyalaya, Siliguri, WB.
2. Dr. Souvik Chatterjee, Scientist E, Materials Science Division, UGC-DAE Consortium for Scientific Research, Kolkata Centre, Sector, III, LB-8 , Bidhan Nagar , Kolkata 700 106.


Running electrical measurements in a CCR (left) and magnetic measurements in a SQUID magnetometer (right).

Arindam Karmakar

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