Synopsis Seminar

Seminar Title	: Investigation of performance of the Bismuth Ferrite based photovoltaic Devices with different configurations
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Venue	: MC 126, Physics Department Seminar Room
Date and Time	: 11 Jul 2024 (11.00AM)

Abstract : Ferroelectric materials in photovoltaic devices show significant potential for future energy harvesting applications due to their high open-circuit voltages. Despite this interest, the mechanism behind the ferroelectric photovoltaic effect remains less understood compared to semiconductor-based technology. In this thesis the photovoltaic characteristics of ferroelectric $BiFeO_3$ (BFO) thin films, enhanced through doping and heterostructure has been explored. Significant current generation in BFO thin films in response to light reveals advancing the application of multiferroic perovskite thin films in solar energy conversion. BFO exhibits light-responsive properties and generates a photovoltaic effect due to intrinsic polarization, with switchable multiferroic photovoltaic behavior influenced by poling voltage. A low-cost and environmentally friendly spin coating technique has been adopted to prepare BFO-based photovoltaic devices. The glass/FTO/BFO/Ag device showed a short-circuit current density (J_{sc}) of &sim4.04 μA/cm^2, open-circuit voltage (V_{oc}) of 0.52 V, Power conversion efficiency (PCE) of 6.22×10^{-2} %, and External quantum efficiency (EQE) of 0.43%. The performance of K-doping BFO ($KBiFe_2O_5$) enhanced the structural, optical, and electrical properties of BFO, resulted improved photovoltaic performance. A bilayer KBFO/BFO device achieved significantly higher J_{sc} of 58.81 μA/cm^2 and V_{oc} of 0.65 V, leading to a PCE of 1.39×10^{-2} % and EQE of 0.72 %,which are &sim22 times higher than BFO and 31 times higher than KBFO-based standalone devices. Devices integrating BFO and KBFO with graphene demonstrated substantial improvements, with the J_{sc} increasing from 4 μA/cm² to 0.8 mA/cm², PCE from 0.0004% to 0.12%, and EQE from 0.43 % to 1.06%. This study provides procedures for optimizing photo absorber layers to enhance multiferroic-based photovoltaic devices.