Seminar

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Institute for Plasma Research

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Title: Study of process parameters affecting secondary phase formation and grain size in Cu_2ZnSnS_4 thin film for solar cell application

Speaker: Mr. Sagar Agrawal
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Date: 25th July 2024 (Thursday)

Time: 02:30 PM

Venue: Seminar Hall, IPR

Abstract

The present thesis is motivated by the development of a potential absorber material (CZTS) for thin-film solar cells (TFSCs). The qualities of CZTS material, such as optimum bandgap (1.4-1.5 eV), high absorption coefficient (10^4-10^5 cm^{-1}), non-toxic and earth-abundant constituent elements, and long-term durability, identify it as a suitable candidate for future TFSCs. The preparation of the CZTS layer in the present work involves a two-step process, starting with magnetron co-sputtering of Cu, Zn, and Sn (thin film precursor) followed by sulfurization. The issue of formation of secondary phases, such as ZnS, SnS, SnS_2, CuS, Cu_2S, Cu_2SnS_3, Cu_3SnS_4, etc., which affect the absorber layer's electrical and optical properties and hence the efficiency of solar cell devices, is addressed. Understanding the formation mechanism of these secondary phases during the growth of CZTS thin film, including its grain growth, is crucial for creating high-efficiency solar cells. The thesis explores the influence of various process parameters on CZTS layer properties, secondary phase formation, and grain size, demonstrating their impact on device efficiency through the fabrication of a multilayer solar cell device. One key obstacle to understanding, how process factors affect secondary phase production, is the inability to quantitatively estimate secondary phases in the CZTS layer because of the limitations of commonly used XRD and Raman spectroscopy methods. In order to address it, XANES spectroscopy is extensively employed in the current work for a tangible, decisive analysis. The talk will cover the results obtained and its correlation to the process parameters.