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Non-Linear Optical probing of MultiFerroicity and Phase Transitions in $BiFeO_3$ Thin Films AMIT KUMAR, Dept. of Materials Science and Engg., Pennsylvania State University, UP, PA, LANE MARTIN, R. RAMESH, Dept. of Materials Science and Engg, University of California, Berkeley, Berkeley, CA , VENKATRAMAN GOPALAN, Dept. of Materials Science and Engg., Pennsylvania State University, UP, PA — Bismuth Iron Oxide $BiFeO_3$ is being studied extensively by researchers to utilize its multiferroic properties for designing multi-state memory devices. In this work , we present the first results of the non linear optical probing of this material to study the simultaneous ferroelectric and antiferromagnetic ordering below the Neel's temperature. Optical second harmonic generation (SHG) has been employed to determine crystal and magnetic symmetries of thin $BiFeO_3$ films grown in different orientations at temperatures ranging from room temperatures to above the Neel's Temperature. We show that SHG can separate the antiferromagnetic and ferroelectric order parameters cleanly and probe each of these phenomena. The coupling between the ferroelectric and antiferromagnetic ordering under electric and magnetic fields will be presented.

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