
Veronica Valentini¹

Eleonora Bolli¹, Matteo Mastellone^{1,2}, Alessandro Bellucci¹, Raffaella Salerno³
Daniele M. Trucchi¹

¹Istituto di Struttura della Materia (ISM-CNR), Consiglio Nazionale delle Ricerche, DiaTHEMA Lab, Via Salaria km 29,300, Monterotondo Stazione, 00015, Roma, Italy

²CNR-ISM, FemtoLAB, U.O.S. Tito Scalo, Zona Industriale, 85050 Tito, Italy

³Dipartimento di Scienze e Tecnologie Chimiche, Università di Roma 'Tor Vergata', 00133 Rome, Italy

veronica.valentini@cnr.it

Temperature-Dependent Raman Spectroscopy as a Tool for the Thermal Characterization of LaB₆ Thin Films

Lanthanum hexaboride (LaB₆) is a promising material for advanced energy and electronic applications owing to its outstanding electron-emission properties in both thermionic and field-emission regimes [1], relatively low work function (2.3–2.7 eV) [2], and high thermal stability [3]. Its potential applications span a broad range of fields, including energy conversion and storage, plasmonics, electronics, thermionics, thermoelectrics, and photonics [4]. Although single crystal LaB₆ is studied since a long time, nanocrystalline LaB₆ thin films represent a novel large-area low-cost solution [5]. A detailed understanding of their thermal behavior and structure rearrangement is therefore essential for the development and optimization of LaB₆-based devices [6].

In this work, temperature-dependent Raman spectroscopy is employed to investigate the thermal stability and evolution of LaB₆ thin films. Raman measurements performed under controlled temperature and atmosphere provide detailed insight into the structural and chemical changes occurring upon heating. In particular, the effects of the substrate and temperature ramp rate are investigated, together with the role of inert-gas flow in the formation and evolution of oxide phases. The reproducibility of the observed thermal behavior, the stability of the material during prolonged exposure to a fixed temperature, and the reversibility of the thermally induced processes are also assessed.

The results demonstrate the potential of temperature-dependent Raman spectroscopy as a non-destructive and versatile approach for monitoring the thermal evolution of LaB₆ thin films and for assessing their suitability for high-temperature applications, including thermionic energy conversion.

References

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