Laser-induced Breakdown Spectroscopy of a Dysprosium Vapor Generated by Laser Ablation

Jhonatha R. Santos[1*], Jonas Jakutis Neto[2], Marcelo G. Destro[2]

[1] *Instituto Tecnológico de Aeronáutica, ITA, São José dos Campos, Brazil,*
[2] *Instituto de Estudos Avançados, IEAv, São José dos Campos, Brazil*

*e-mail: jhonatharicardo@gmail.com

The dysprosium isotopes have applications in several areas. Noteworthy is the ^{164}Dy isotope that can be used to improve nuclear control rods[1]. Given that, the IEAv demonstrated interest in the study of such element and the possibility to obtain isotopic enriched dysprosium for strategic purposes. The laser isotope separation process consists of several steps and one of them is the vapor generation. This step involves the production of a neutral metallic vapor by laser ablation, which is a requirement for the selective photoionization step. In this work, a Nd:YAG pulsed laser beam is focused on a metallic Dy foil inserted into a vacuum chamber pressurized with argon gas at 40 mbar. This creates a Dy breakdown plasma just above the surface. The investigation of the plasma is performed using the laser-induced breakdown spectroscopy (LIBS) technique. LIBS is a versatile technique for analyzing and measuring the concentration of materials in solid and liquid samples[2]. From the emission spectra obtained by LIBS and using the Saha-Boltzmann method[2], it was estimated the temperature (7293 ± 167 K) and electron density (1.8×10^{17} cm^{-3}) of the plasma close to the laser incidence region.. Another important result obtained from the experiment is the electron impact width parameter for a few dysprosium emission lines such as 598.856 nm, 597.449 nm and 594.579 nm. Once determined this parameter, it will be possible to estimate the electron density of the vapor at different location of the expansion and varying laser parameters, only by monitoring the broadening of the related emission lines[3,4].

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