Strategies to produce and characterize Rare-Earth atomic jets produced by laser ablation for the IEAv isotope separation program

Jonas Jakutis Neto[1*], Benedito Christ[1], Nicolau A. S. Rodrigues[2], Marcelo G. Destro[1,2], José W. Neri[1], Jhonatha R. dos Santos[2] and Patricia Bueno[2]

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

*e-mail: jakutis@ieav.cta.br

One front of the IEAv Rare-Earth (RE) isotope separation program is the atomic vapor generation by laser. This work shows the strategy and efforts required to reach the expertise to produce a well-tailored RE atomic jet using laser ablation, achieving the requirements for the photoionization process. For this project three Nd:YAG Q-switched lasers are available delivering energies per pulse (8 ns, 10 ns and 25 ns) from few μJ to hundreds of mJ at 1064 nm, 532 nm and 355 nm. Second and most important, the vapor created must be characterized as a function of the laser parameters in order to provide an atomic vapor with the characteristics required for the photoionization, they are: it must have only neutral species; optimum density distribution (low densities = low material collection; too high densities = enrichment efficiency reduction) and the jet should be reasonably collimated. Therefore, four characterization techniques are going to help tailoring the jet: LIBS (Laser Induced Breakdown Spectroscopy); Pressure sensor PVDF (polyvinydilene fluoride); Electrostatic probe; and LIF (Laser Induced Fluorescence). Each of these will allow to access a few important parameters needed to understand and control the vapor, as shown in Figure 1(a). LIF applied to the atomic will also help to uncover the odd isotope hyperfine lines, with very low Doppler broadening.

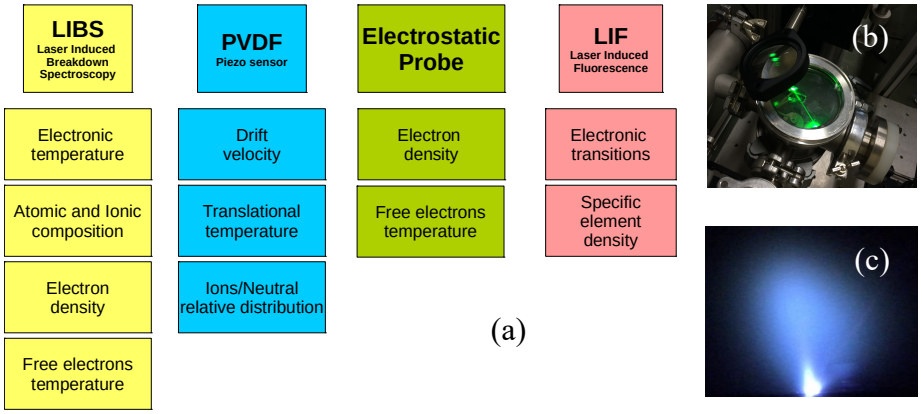

Figure 1: (a) The diagram with the characterization techniques with the respective parameters monitored. (b) LIBS setup image and (c) a typical atomic vapor obtained in the laboratory.

Finally, the current status of the atomic vapor project is focused on developing the PVDF measurement system together with the electrostatic probe system, collecting LIBS spectra (recently achieved for Dysprosium) and begin the LIF spectroscopy.

The authors acknowledge Comaer-DCTA, Funcate, CNPq, CAPES and FAPESP.