High Resolution Spectrum of La-Ar Hollow Cathode Lamp in Near-Infrared Region

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Abstract. The atomic emission spectra of La-Ar plasma have been recorded using a high-resolution *Bruker IFS-125 HR* Fourier transform (FT) spectrometer with a resolution of 0.05 cm^{-1} at the Laser Centre of the University of Latvia in Riga. The rare-earth metal lanthanum (Z=57) has only one stable isotope, ^{139}La, with a natural abundance of 99.911%.

For the first time, a systematic analysis of the spectrum of an La-Ar plasma in the near-infrared spectral range is presented. The aim of this work is the classification of spectral lines and a comprehensive study of lanthanum lines covering the region from 833 nm to 1665 nm (6000 cm^{-1}-12000 cm^{-1}). The classification of spectral lines is done with a classification program [1], which shows all suggestions of possible transitions for the particular wavelength of a spectral line, taking into account the selection rules for electric dipole radiation. The center of gravity wave number of spectral lines could be determined with an accuracy better than 0.01 cm^{-1}. Because the La spectrum is very dense (which means exhibiting many lines per wavelength interval), the hyperfine structure of La is needed as a "fingerprint" to choose the correct classification for unknown transitions.

In total, 2385 hyperfine structure patterns have been observed in the FT spectra. Of these, 710 are new lines, which are not listed in commonly used wavelength lists [2-7]. We have assigned 418 unclassified lines as atomic La lines and 8 lines as singly ionized La. Further, 199 lines are assigned as atomic Ar lines and 85 lines as singly ionized Ar. Additionally, we have observed 223 lines which have hyperfine structure patterns in FT spectra, but none of them have transition suggestions in the classification program [1]. These transitions should be related to new, as yet unknown energy levels.

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