The Ag I and Au I Resonance Line Broadening in Helium Plasma

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The shapes and shifts of the resonance spectral lines of neutral silver (Ag I: 328.068 and 338.289 nm) and gold (Au I: 242.795 and 267.595 nm) have been measured in a laboratory helium plasma of about 18,500 K electron temperature and an electron density ranging between $0.78 \cdot 10^{23}$ and $1.24 \cdot 10^{23}$ m^{-3}. Stark broadening has been found as the dominant mechanism of the line shape and position formation. Our measured Ag I and Au I resonance line Stark widths (W) and shifts (d) are the first reliable experimental data. They are compared with calculated single Ag I and Au I W and d data based on a semiclassical approach. The measured values are higher than the calculated ones, especially of the Au I resonance lines. Besides, we have calculated the hyperfine structure (hfs) components and their relative intensities of the mentioned Ag I and Au I lines. Strong asymmetry between the red and blue components of the hfs was found. A modified version of the linear, low-pressure, pulsed arc was used as plasma source operated in helium with silver and gold atoms as impurities, evaporated from silver and gold cylindrical plates located in the homogeneous part of the discharge providing conditions free of self-absorption. At the above mentioned helium plasma conditions the splitting in the hyperfine structure (Δ_{hfs}) of the Ag I and Au I resonance lines has been overpowered by Stark and Doppler broadenings. We estimate that at electron densities below 10^{20} m^{-3} and electron temperatures below 10,000 K the hfs components in the 267.595 nm and 242.795 nm Au I lines play an important role in the line shape formation, and the resulting line profiles can be used for temperature estimation in optically thin plasmas.

Key words: Plasma Spectroscopy; Line Profiles; Atomic Data.