Spectroscopic line behavior in a DC copper vacuum arc operated with background gas
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The behavior of some selected visible spectral lines emitted in the interelectrode space of a copper vacuum arc operated with background gases (mainly Oxygen gas) is determined in terms of the gas filling pressure value. It is found that the behavior of these CuI and CuII lines with the gas pressure value is essentially the opposite; after an intensity "plateau" at low-pressure values, the CuI line intensity grows, while the corresponding CuII intensity decreases. On the other hand, no transitions corresponding to CuIII were registered within the spectral range investigated (340 to 600 nm). The measured line intensities are compared with the particle densities calculated with a one-dimensional model, which include four metallic species (having no inner structure) with different charge state, and takes into account ion slowing down by elastic scattering with neutrals, radial diffusion loses to the chamber wall, charge-exchange processes with neutrals and ionization (or recombination) of the gas molecules (or gaseous ions) by electron impact. It is inferred that the population of an excited level responsible for a given emission line is much smaller (of the order of $10^3$-$10^4$cm$^{-3}$) than those expected for the fundamental levels of the particles. The explanation for the observed behavior of these spectral lines with the pressure value rests on the local generation of excited states from lower lying levels by electron impact, but admitting the presence of a certain amount of metal vapor (generated by microdroplet evaporation in the vicinities of the cathode surface) in the interelectrode region.