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Study of the spray to globular transition in gas metal arc welding: a spectroscopic investigation

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Abstract: The gas metal arc welding (GMAW) process is strongly influenced by the composition of the shielding gas. In particular, addition of CO_2 increases the threshold current for the transition from unstable globular to more stable spray transfer mode. We report on the diagnostics—using optical emission spectroscopy—of a GMAW plasma in pure argon and in mixtures of argon, CO_2 and N_2 while operated in spray and globular transfer modes. The spatially resolved plasma parameters are obtained by applying the Abel transformation to laterally integrated emission data. The Stark widths of some iron lines are used to determine both electron density and temperature, and line intensities yield relative contents of neutral and ionized iron to argon.Our experimental results indicate a temperature drop on the arc axis in the case of spray arc transfer. This drop reduces with addition of N_2 and disappears in globular transfer mode when CO_2 is added. Despite the temperature increase, the electron density decreases with CO_2 concentration. The highest concentration of iron is observed in the plasma column upper part (close to the anode) and for GMAW with CO_2.Our results are compared with recently published works where the effect of non-homogeneous metal vapour concentration has been taken into account.

Keywords : GMAW, Optical Emission Spectroscopy, Boltzmann Plot