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Flow Dynamics from a Nonequilibrium Atmospheric-Pressure Arc Discharge Jet JUAN TRELLES, University of Massachusetts Lowell — Plasma jets are used as directed sources of energy, momentum and excited species fluxes in diverse technologies, such as spray coating, chemical synthesis, waste treatment and pyrolysis. The fluid, thermal and electromagnetic dynamics from the jet produced by a direct-current non-transferred arc plasma torch are explored using time-dependent three-dimensional simulations encompassing the dynamics of the arc inside the torch, the development of the jet through the outside environment, and the later impingement of the jet over a substrate. The plasma flow is described mathematically by a chemical equilibrium and thermodynamic nonequilibrium (two-temperature) model and numerically by a coupled fluid-electromagnetic transport model and a Variational Multiscale Finite Element Method. Simulation results uncover various aspects of the flow dynamics, including the jet forcing due to the movement of the arc, the prevalence of deviations between heavy-species and electron temperatures in the plasma fringes, the development of shear flow instabilities around the jet, the occurrence of localized regions with high electric fields far from the arc, the fluctuating expansion of the gas ejected from the torch, and the formation and evolution of coherent flow structures.

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