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Simulating the Spontaneous Formation of Self-Organized Anode Spot Patterns in Arc Discharges JUAN TRELLES, University of Massachusetts Lowell — Self-organized pattern formation is a captivating phenomenon common in numerous biological, chemical and physical systems. The experimental observation of self-organized anode patterns in diverse types of electrical discharges, including atmospheric-pressure arc discharges, has been well reported and characterized in the plasma literature. Nevertheless, the capturing of anode pattern formation in arc discharges by fluid flow models has proven exceedingly elusive. For the first time computational simulations, based on a time-dependent three-dimensional thermodynamic nonequilibrium model, reveal the spontaneous formation of self-organized anode attachment spots patterns in a free-burning arc. The characteristics of the patterns depend on the total arc current and on the resolution of the spatial discretization, whereas the main properties of the plasma, such as maximum temperatures, velocity, and voltage, depend only on the former. The obtained patterns qualitatively agree with experimental observations and confirm that the spots originate at the fringes of the arc - anode attachment. The results imply that heavy-species - electron energy equilibration, in addition to thermal instability, has a dominant role in the formation of anode spots in arc discharges.

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