Stationary States of Hydrogen-Producing Reactions in Nonequilibrium Plasma

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Abstract

In this work, stationary states in nonequilibrium plasmas of chemical reactions that can produce hydrogen are explored, namely the water splitting and water gas shift reactions. For both reactions, the effluent from the reactor at long gas residence times in the plasma was found to be independent of the influent speciation. In other words, feeding the reactor either 0.1 H2O or 0.1H2+0.05O2 by mole produced the same effluent composition, and similarly, feeding the reactor 0.1CO+0.1H2O produced nominally the same effluent as 0.1CO2+0.1H2. For both reactions, the effluent from the plasma was found to be very far from local equilibrium at the total pressure and background temperature of the reactor. An important conclusion of this work is that special attention must be paid to the recombination zone in plasma chemical processes. The recombination zone tends to drive the gas composition from plasma stationary states back towards local equilibrium.

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