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Modeling plasma glow discharges in Air near a Mach 3 bow shock with KRONOS SEBASTIEN RASSOU, JULIEN LABAUNE, DENIS PACKAN, PAUL-QUENTIN ELIAS, ONERA — In this work, plasma glow discharge in Air is modeled near a Mach 3 bow shock. Numerical simulations are performed using the coupling KRONOS which have been developed at ONERA. The flow field is modeled using the code CFD: CEDRE from ONERA and the electrical and plasma part by the EDF open-source code CODE_SATURNE. The plasma kinetic modeling consists on a two-term Boltzmann equation solver and a chemical reaction solver depending of the electric field. The coupling KRONOS is fully parallelized and run on ONERA supercomputers. The shock wave is formed by the propagation of a supersonic flow (M = 3) through a truncated conical model mounted with a central spike. Depending on the spike's voltage value, corona, glow or arc regime could be obtained in a steady flow. The parameters for the supersonic flow and the spike configurations are chosen to be in glow discharge regime and to reproduce the experimental setup. In our simulations, 12 species and 80 reactions (ionization, electronic or vibrational excitation, attachment etc ...) are considered to properly model the glow discharge and the afterglow. In a stationary flow, glow discharge is observed only at the upstream of the shock wave near the high voltage spike. Behind the bow shock, in the afterglow, negative ions are provided by electrons attachment with O2. The negative ions flow convection ensures the electrical conduction and the establishment of the glow discharge.

Sebastien Rassou
ONERA

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