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Laboratory modeling of hypersonic flight conditions[1] ALEXEY SHASHURIN, George Washington University, MADHUSUDHAN KUNDRAPU, JOHN LOVERICH, Tech-X Corporation, ISAK BEILIS, Tel Aviv University, MICHAEL KEIDAR, George Washington University — One of the key issues for vehicles in hypersonic flight and during atmospheric reentry is radio blackout due to weakly-ionized air plasma formation. When a spacecraft enters Earth's atmosphere or a vehicle travels through the atmosphere at hypersonic velocities, a shock wave is formed in front of the vehicle. The shock wave converts much of the vehicle's kinetic energy into heat and as a result the air molecules are dissociated and ionized. This plasma layer prevents normal telemetry transmission. This work considers a new approach to model the conditions of hypersonic flight in laboratory environment. The approach utilizes hypersonic plasma jet created by vacuum arc that hits immovable object intended to model a hypersonic vehicle. Heating of the object by the arc causes immediate re-evaporation of the jet's metal ions being deposited on the object's surface. This mimics absence of attachment of the air molecules to the vehicle in hypersonic flight. The plasma parameters and object temperatures are measured using electrostatic Langmuir probes and thermocouples respectively. The results of these experiments can be also used as calibration tool for tuning and debugging of numerical codes intended to predict and mitigate the blackout problem.

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