Abstract Submitted
for the GEC06 Meeting of
The American Physical Society

Modeling of plasma-assisted combustion in premixed air-fuel supersonic flows ANATOLY NAPARTOVICH, IGOR KOCHETOV, Troitsk Institute for Innovation and Fusion Research, SERGEY LEONOV, Institute of High Temperature RAS, TRINITI TEAM, IHT RAS COLLABORATION — Numerical model was developed combining traditional approach of thermal combustion chemistry with advanced description of the plasma kinetics based on solution of electron Boltzmann equation. This approach allows us to describe self-consistently strongly non-equilibrium electric discharge in chemically unstable gas. A comparison is made between plasma-assisted and thermal ignitions for the hydrogen/air and ethylene/air mixtures. A pseudo-one-dimensional plug flow model was developed to calculate gas flow evolution in plane duct. Numerical simulations predicted a notable reduction of the ignition length and the energy input in the discharge required for the ignition of the pre-mixed fuel. In particular, for the hydrogen/air mixture in the duct of length 80 cm, the inlet static gas temperature 700 K and static gas pressure 1 bar the minimum reduced energy input in the dc glow discharge is 150 J/g, while for the thermal ignition it is as twice as high. The numerical simulation of dc discharge-initiated combustion of a hydrogen-air mixture in a supersonic duct has shown that the effects of acceleration is not very sensitive to the fuel/oxidant ratio and gradually decreases with fuel dilution. It is shown that the ethylene/air mixture can be ignited by the glow discharge at the reduced energy input 1.6 times greater than the hydrogen/air mixture.

Anatoly Napartovich
Troitsk Institute for Innovation and Fusion Research

Date submitted: 04 Jun 2006 Electronic form version 1.4