Microwave Discharge of High Gas Pressure and its Possible Application in Plasma Aerodynamics and Plasma Assisted Combustion

Kirill V. Khodataev
Moscow Radiotechnical Institute RAS, Russia (MRTI)

Within last 20th years MRTI, having created specialized bench base, carries out experimental and theoretical researches of physics of gas discharges of a high pressure in the field of microwave

(MW) radiations and basic researches of possibilities of their application.

The purpose - working out of new control methods of

- flows in channels of engines and around flying machines and
- processes of ignition and burning stabilization in aviation and automobile engines.

Researches have revealed a number of the important properties for applications

1. The MW discharge can be created remotely at a distance from a source

2. At pressure of a gas mix, more 0.1 atm, the discharge in the field of a pulse MW radiations represents dynamically developing network of thin hot channels (the streamer MW discharge)

3. The vapors mix and an aerosol component makes insignificant impact on properties of MW discharge

4. The streamer discharge is capable to develop in the field of the MW radiation, which intensity on orders less critical (breakdown) value (subcritical MW discharge).

5. The subcritical MW streamer discharge distribution occurs with a speed of some kilometers per second and can be carried out in streams, moving with high speed

6. The subcritical streamer MW discharge possesses high absorbing ability in which basis resonant interaction of system of streamer channels with MW radiation lays

7. The temperature in the streamer channels in time ~ 1 μs rises to 5000-10000 K

8. The subcritical streamer discharge in a combustible gas mix initiates burning in a wide range of its specific composition and speed of a stream (up to the supersonic).

9. The streamer channels are a source of braking UV radiation with of some electron-volt energy, increasing speeds of chemical reactions in gas mixes

10. In certain conditions the streamer discharge can cause a detonation of a combustible gas mix.

The MW discharge properties open a wide area of applications.

The experimental results on discharge influence on aerodynamics of streamlined bodies (drag reduction, lateral force creation in

supersonic airflow, boundary layer control, and others) and on MW discharge ignited and assisted combustion are represented.

Achievements in researches of physics of the initiated discharges in the field of MW radiation have allowed to start working out of MW plasma technologies with reference to problems of aerodynamics of supersonic flying vehicles, initiation and the burning stabilization in combustion chambers of jet engines and internal combustion motors.

The results received at the initial stage of these works specify in correctness of the initial backgrounds making a principal basis for future MW plasma technologies in specified directions. Their application with a high probability will lead to new achievements in development of techniques of new generation