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Efficiency of Nanosecond High–Voltage Discharge in Ignition and Combustion Enhancement

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The problem of a fast homogeneous ignition of a combustible mixture is topical. High electric field in a front of nanosecond discharge and behind it results in effective ionization, dissociation and excitation. Two topics will be discussed: the efficiency of nanosecond discharges as active particles generator for ignition and study of nanosecond barrier discharge influence on a flame. Experimental results of a shift of ignition delays under the discharge are obtained for a set of combustible mixtures with H2 or hydrocarbons (up to C5H12) in a temperature range of 700– 2300 K and pressure range of 0.1-1.5 atm, numerical modeling was performed for the same conditions. Comparative study of laser flash-photolysis and nanosecond discharge allowed us to make a conclusion about a role of excited atomic oxygen in the process of ignition. Experiments on plasma–assisted combustion with a nanosecond barrier discharge at atmospheric pressure have demonstrated that with energy input negligible in comparison with burner's chemical power, it is possible to obtain double flame blow-off velocity increase. The role of addition of different radicals and excited species by the discharge is discussed. The lecture will be based on works carried out at the Laboratory of Physics of Nonequilibrium Systems of MIPT. In collaboration with Ilya Kosarev, Eugene Mintoussov, Andrei Nikipelov, and Andrei Starikovskii of the Moscow Institute Physics and Technology.