Technical Program and Abstracts

St. Petersburg, Russia
October 4-8, 2010

7th International Colloquium on Pulsed and Continuous Detonations

Experimental study of deflagration-to-detonation transition in natural gas – air mixture

S. M. Frolov, V. S. Aksenov, V. S. Ivanov, S. N. Medvedev, A. A. Skripnik, V. A. Smetanyuk

N.N. Semenov Institute of Chemical Physics, 4 Kosigin Street, Moscow 119991, Russia

The operation process in a high-intensity pulse-detonation burner of natural gas has been demonstrated for the first time. The paper presents the results of experimental studies of intermittent DDT in the flow of natural gas (methane content 98.6%) – air mixture at a frequency of about 0.1 Hz. The pulse-detonation burner demonstrator comprised continuous fuel and air feeding systems and a complex-geometry duct with a prechamber, expansion volume, and 94-millimeter diameter 3-meter long tube open to the atmosphere. The flame was ignited in a prechamber by a standard automobile spark plug and transitioned first to an expansion volume with perforated partitions and then to the tube partly blocked with shaped obstacles. According to pressure and luminescence records in different locations along the burner, fast turbulent combustion in the expansion volume resulted in the formation of a strong shock wave followed by turbulent flame in the attached tube. Secondary explosions stimulated by the shaped obstacles in the tube then resulted in fast DDT with the lead-shock propagating velocity exceeding 1900–2000 m/s at the transition stage and stabilizing on the level of 1700 m/s in the course of further propagation through obstructed and unobstructed parts of the tube. Oscillatory pressure records in the detonation wave indicate that a detonation propagates in the limiting spinning mode.