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Deflagration-to-detonation transition control by high voltage nanosecond discharges ANDREI STARIKOVSKII, Drexel University, ALEKSANDR RAKITIN, NEQLab Research — A smooth square detonation tube with a transverse size of 20 mm and a single-cell discharge chamber has been assembled to study DDT mechanisms under initiation by high-voltage nanosecond discharges. Stoichiometric propane-oxygen mixture was used at initial pressures of 0.3 and 1 bar. Two general mechanisms of DDT initiation have been observed and explained under the experimental conditions. When initiated by a spark, the mixture ignites simultaneously over the volume of the discharge channel, producing a shock wave with Mach number over 2 and a flame wave. The waves then form an accelerating complex, and, after it reaches a certain velocity, an adiabatic explosion occurs resulting in DDT. At 1 bar of initial pressure, the DDT length and time do not exceed 50 mm and 50 μs, respectively. Under streamer initiation, the mixture inside the discharge channel is excited non-uniformly. The mixture is first ignited at the hottest spot with the shortest ignition delay, which is at the high voltage electrode tip. Originating at this point, the ignition wave starts propagating along the channel and accelerates up to the CJ velocity value. The initiation energy is by an order of magnitude lower for the streamer-gradient mode when compared to the spark initiation.

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