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Features of dilute methane–oxygen flame front propagation towards combustible gas flow created by the fan

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Flame propagation in stoichiometric mixtures of methane with oxygen diluted with CO_2 and Ar at initial pressures of 100–200 Torr and 298 K in a horizontal cylindrical quartz reactor 70 cm in length and 14 cm in diameter was investigated. The reactor was fixed in two stainless steel gateways at butt-ends supplied with inlets for gas pumping and blousing and a safety shutter, which swung outward when the total pressure in the reactor exceeded 1 atm.[S1] A pair of spark ignition electrodes was located near the left butt-end of the reactor.[S1] A EC8010L fan (2500 rpm, 1.4 W, 0.51 m^3/min, 0.03 mm H_2O) was placed at the right butt-end of the reactor; the fan had two additional speeds: 1250 rpm and 625 rpm. Two thin obstacles were used: the obstacle (1) 140 mm in diameter with a single circular opening of 22 mm in diameter, the obstacle (2) with two asymmetrically arranged circular openings 20 mm in diameter (the first one is located at the center, the second one - in 40 mm from the center). The limiting diameter for flame penetration through the single opening under conditions of the work is 20 mm.[S1,S2] Each of the obstacles was placed vertically at the center of the reactor (Figure S1). The combustible mixture (15.4% CH_4 + 30.8% O_2 + 46% CO_2 + 7.8% Ar) was previously prepared; CO_2 was added to enhance the quality of filming by decreasing flame velocity; Ar was added to diminish the discharge threshold. The reactor was filled with the combustible mixture to necessary pressure. Then, spark initiation was performed (discharge energy 1.5 J).

Speed filming of ignition dynamics and flame front propagation was carried out from the side of the reactor with a Casio Exilim F1 Pro digital camera (frame frequency, 600 s^{-1}).[S1–S3] The video file was stored in computer memory and its time-lapse processing was performed. Chemically pure reagents were used.

References

S1 N. M. Rubtsov, V. I. Chernysh, G. I. Tsvetkov and K. Ya. Troshin, *Mendeleev Commun.*, 2023, **33**, 279.

S2 N. M. Rubtsov, V. I. Chernysh, G. I. Tsvetkov and K. Ya. Troshin, *Mendeleev Commun.*, 2018, **28**, 99.

S3 N. M. Rubtsov, V. I. Chernysh, G. I. Tsvetkov and K. Ya. Troshin, *Mendeleev Commun.*, 2017, **27**, 101.

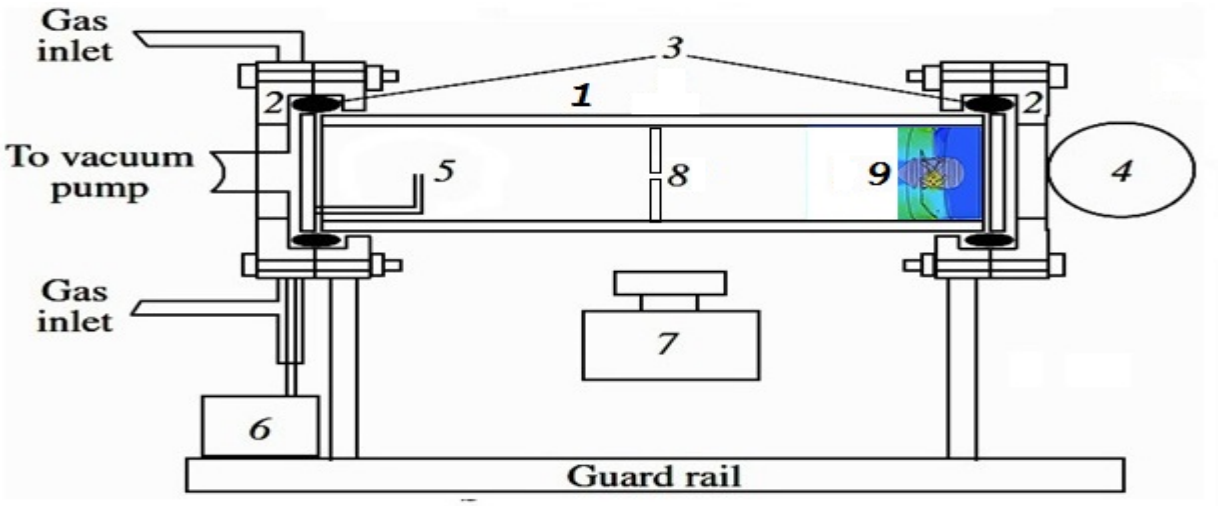

Figure S1 Experimental installation: *1* – quartz cylindrical reactor, *2* – stainless steel gateway, *3* – silicone laying, *4* – stainless steel shutter, *5* – spark electrodes, *6* – power supply, *7* – movie camera Casio Exilim F1 Pro, *8* – obstacle (1), *9* – fan.