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Loss of stability and re-stabilization of flat porous-plug burner flames MOSHE MATALON, University of Illinois at Urbana-Champaign, VADIM KURDYUMOV, CIEMAT — In our recent studies of edge-flames we found that when the characteristic gas velocity exceeds a critical value the flame may undergo spontaneous oscillations. The oscillations are amplified as the flow rate increases reaching maximum amplitude and then decrease by further increasing the flow rate until the flame re-stabilizes. In this work we examine the concept of flame restabilization in a simpler but related problem – the planar premixed flame on a porous-plug burner - which is amenable to a full stability analysis. We show the dependence of all possible steady states on the relevant parameters including the mass flow rate, the effective Lewis number of the mixture, the overall activation energy of the chemical reaction and the extent of heat release. A linear stability analysis is carried out to examine whether these steady states are stable to small disturbances. The analysis determines the critical conditions for the onset of instability as well as the nature of the instability. In particular we show that by decreasing the mass flow rate the flame, which is at first stable, starts to oscillate back and forth for a limited range of gas velocities but is then restabilized by further decreasing the mass flow rate. We also show that the properties of the plug, such as the thickness of the plate and its porosity, play a significant role on flame stabilization.

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