A pulsed Nd:YAG laser is used to study laser spark ignition of methane counter-flow diffusion flames with the use of helium and argon as diluents to achieve a wide range of variations in transport properties. The global strain rate and Damköhler number on successful ignition were investigated for the effects of Lewis number and transport properties, which are dependent on the diluent type and dilution level. A high-speed camera is used to record the ignition events and a software is used for pre-ignition flow field and mixing calculations. It is found that the role of effective Lewis number on the critical global strain rate, beyond which ignition is not possible, is qualitatively similar that on the extinction strain rate. With the same level of dilution, the inert diluent with smaller Lewis number yields larger critical global strain rate. The critical Damköhler number below which no ignition is possible is found to be within approximately 20% for all the fuel-inert gas mixtures studied. When successful ignition takes place, the ignition time increases as the level of dilution of argon is increased. The ignition time decreases with increasing level of helium dilution due to decreases in thermal diffusion time, which causes rapid cooling of the flammable layer during the ignition process. However, the critical strain for ignition with helium dilution rapidly decreases as the dilution level is increased. The experimental results show that with the increase of strain rate the time to steady flame decreases, and that with the increase of dilution level time for the flame to become steady increases. For the same level of dilution, the time for steady flame is observed to be longer for He-diluted flames than for Ar-diluted flames due to the difference in thermal diffusivity between the two diluents.

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The public is welcome to attend.