Akshita Swaminathan et al., J Aeronaut Aerospace Eng 2018, Volume 7
DOI: 10.4172/2168-9792-C2-025

LIC-laser induced combustion

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Combustion is critically important as it provides about 80% of the energy requirement of the world. In the last five decades, emphasis on combustion focuses on two aspects viz., improving quality of combustion and addressing the risks/hazards. With recent advancement, an aspect which is researched upon is the combustion behaviour in the presence of laser flow. Lasers are well known as potential, cheaper, point-precise and high speed sources of energy. Their applications pertain to propulsion, energy generation, artillery, fire safety and defence support systems. Enhanced energy requirement has necessitated active research efforts to fundamentally understand combustion behaviour in the presence of alternative energy sources. Major application of this includes the direct energy weapons (DEWs). The governing principle of DEW is transmission of high energy with the use of lasers and/or microwaves introducing uneven heat stresses and leading to the failure of structural integration eventually causing its destruction. The unique properties of DEW includes travelling at the speed of light with no complicated trajectory calculations (ensuring the target is in the line of sight), not being affected by gravity, its invisibility and its ability to take on multiple targets from a stand-off distance. Present work is motivated by the need to have better combustion and enhanced fire safety. The investigation is carried out to explore the laser-combustion interactions and identification of the effects. An experimental setup was upraised comprising of varying intensity lasers, paraffin wax candles, incense sticks, concave and convex lenses, optical setup (shadowgraph) and stopwatch. The effect was simplified by quantification of flame spread rate (candle) and smouldering regression rate (incense stick) variation. The parametric variations include external energy source (laser) separation distance, laser intensity, and different source (laser) configurations. Systematic experimentation was carried out under normal gravity conditions and results were compared with the base case of combustion without any external influence. Result indicates that lasers significantly affect the combustion process in both modes-flaming and smouldering which project lasers as a potential futuristic energy source to test and analyse combustion systems and design laser induced combustion systems.

Biography

Akshita Swaminathan is pursuing her BTech in Aerospace engineering at SRM Institute of Science and Technology. Her areas of interest include space exploration, rocket propulsion, combustion and aircraft structures. She is in her third year of study.

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