



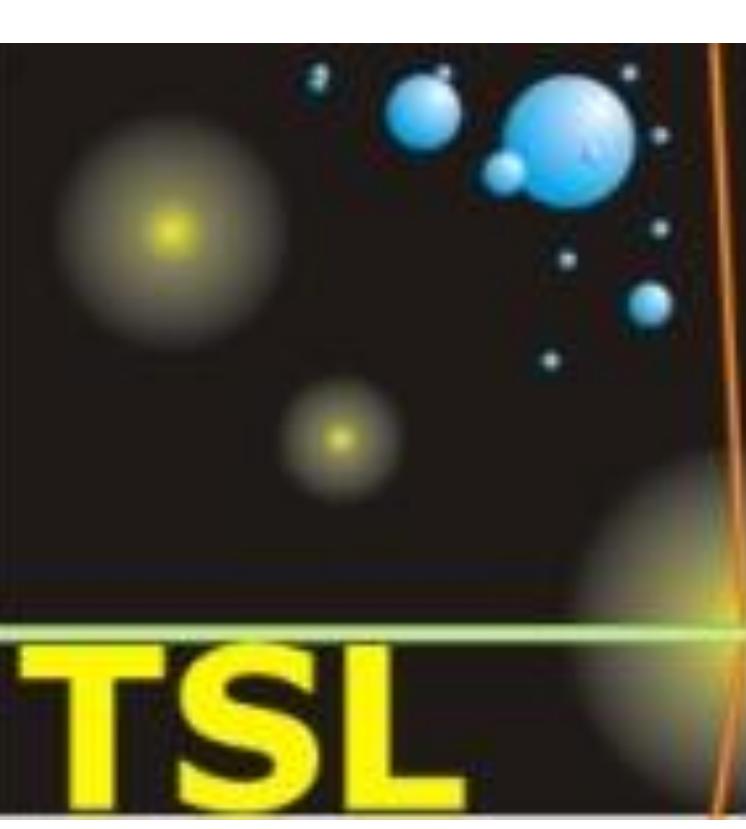
# Spherical Flame Characteristics of Heptane/Iso-Butanol Mixture Droplets

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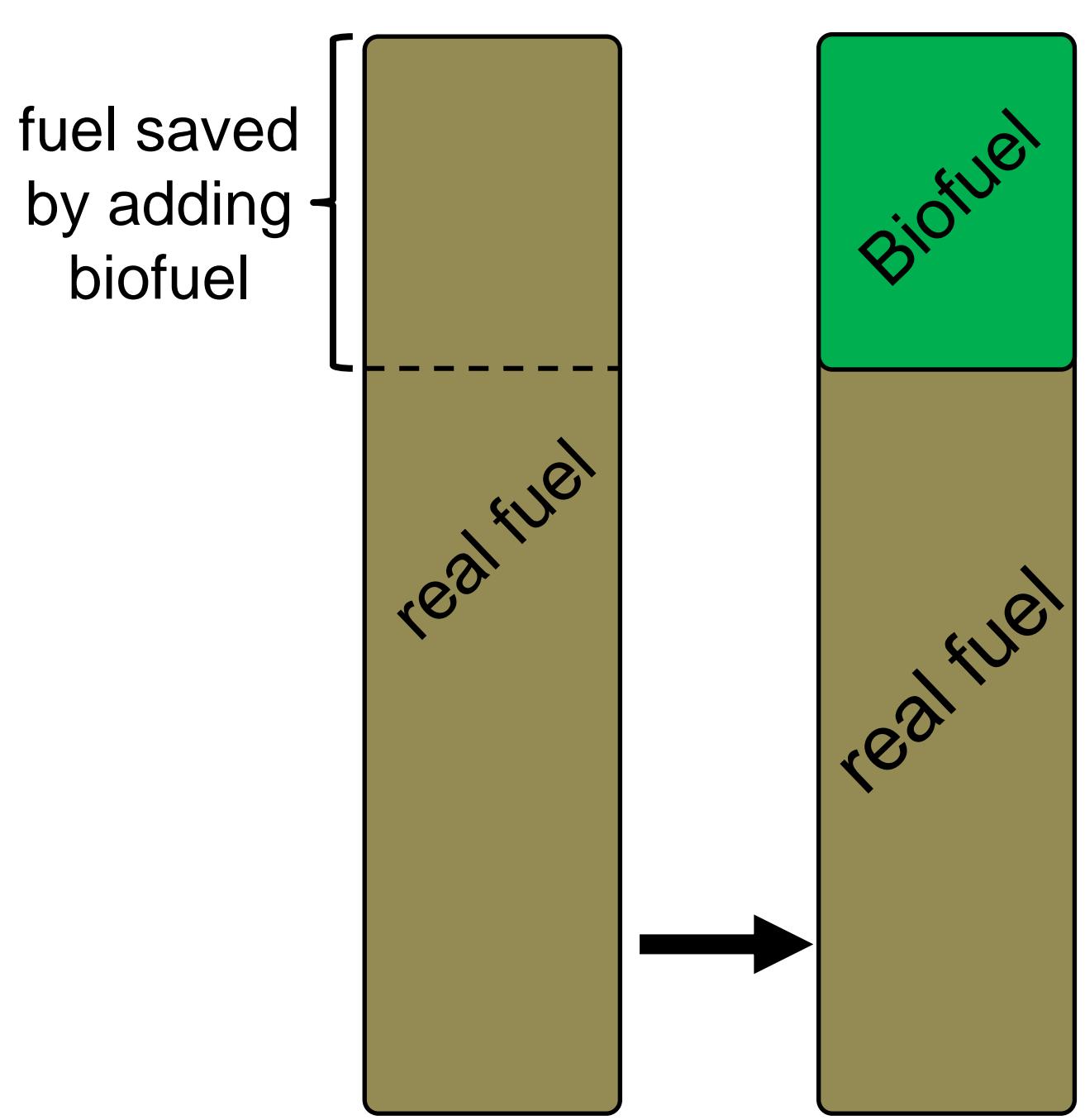
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## Background

### Blending Biofuels with Transportation Fuels

- Biofuels are fuels derived from biological feedstock (eg. ethanol from corn).
- Biofuels are actively being investigated as potential transportation fuel additives largely due to their renewability and their superior combustion properties to ethanol.
- Blending biofuels with transportation fuels can significantly reduce the transportation industry's overall reliance on fossil fuels.
- Purpose of study: identify the combustion characteristics of biofuel and diesel blends.

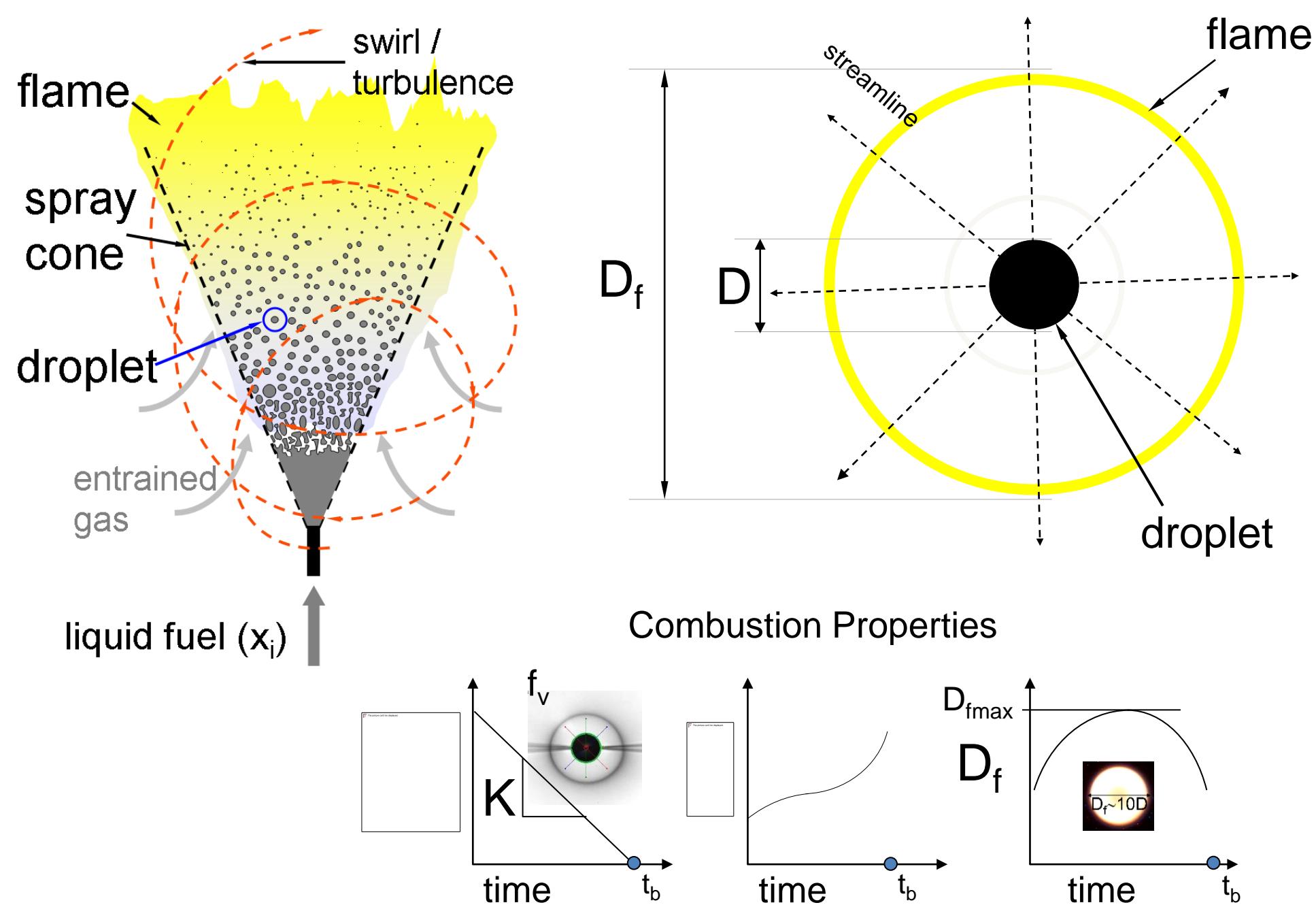


### Use Surrogate to Model Diesel/Biodiesel Blend

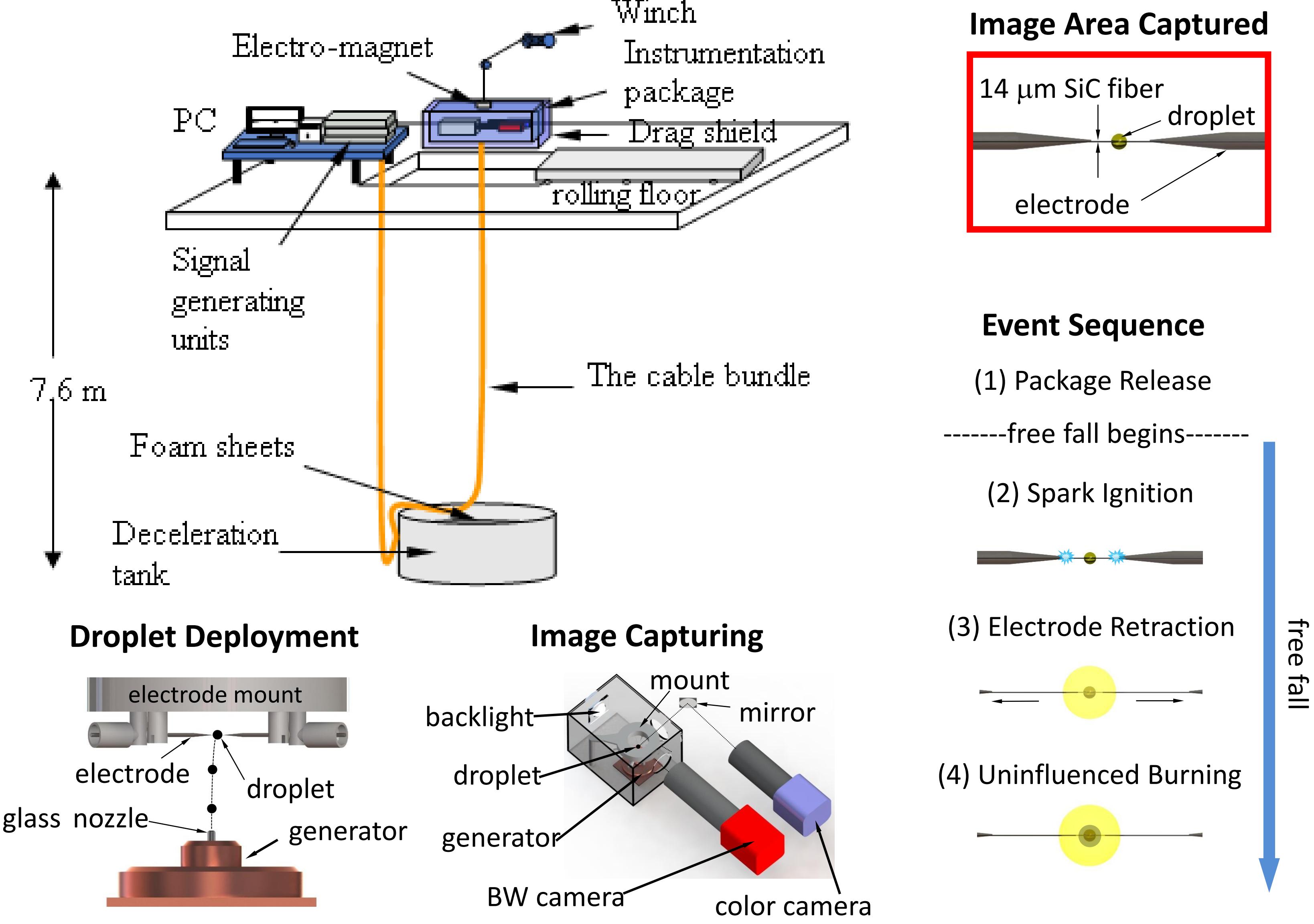
- Gasoline is a multi-component fuel. Heptane is a PRF component for gasoline.
- iso-butanol, a promising biofuel wth a high "merit function"

### Combustion Properties from a Single Droplet

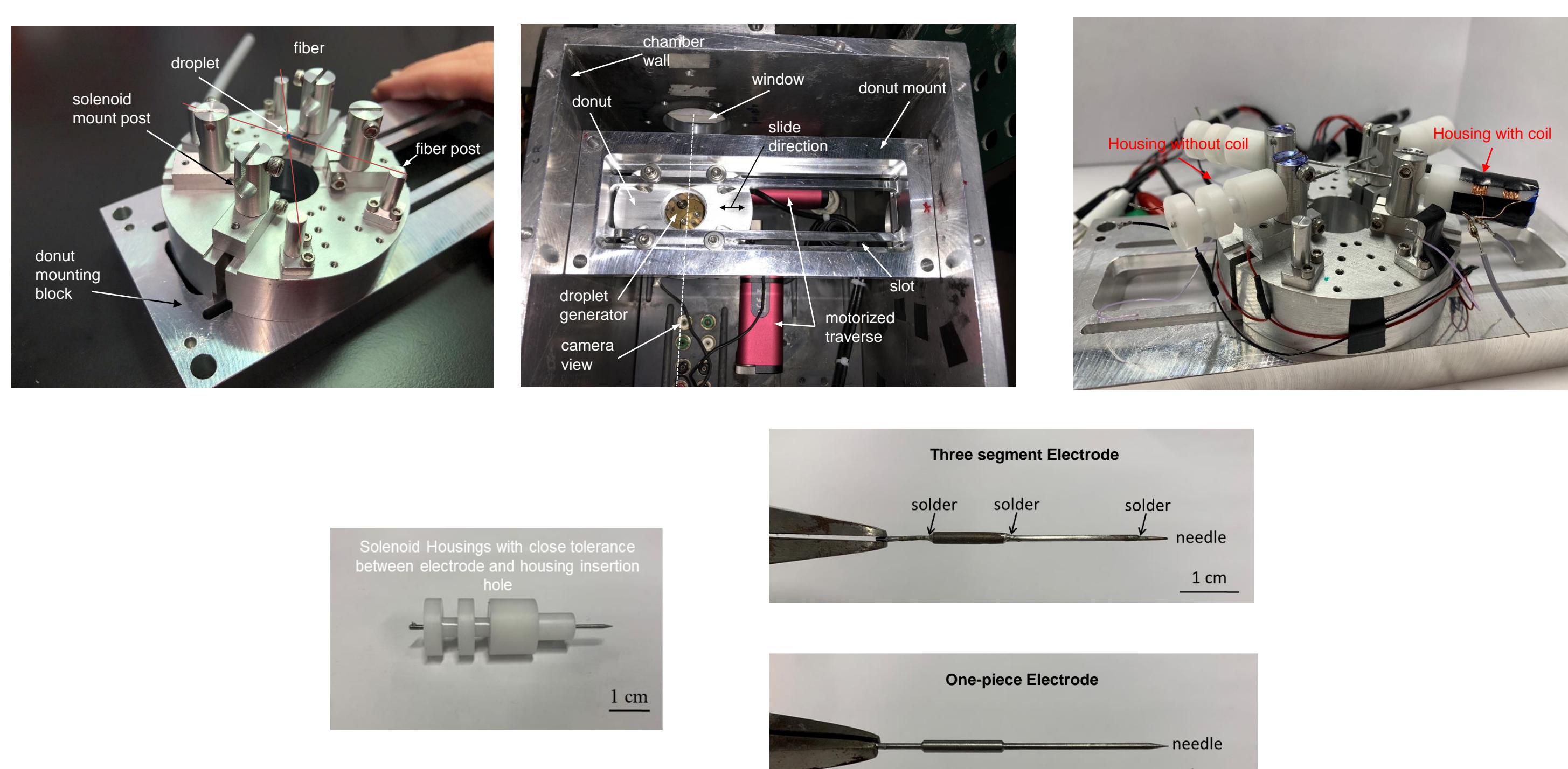
- Sprays are not well controlled environments.
- Consider only a single element of the spray: a droplet.
- Remove convection to create spherical symmetry.
- Extract combustion properties.



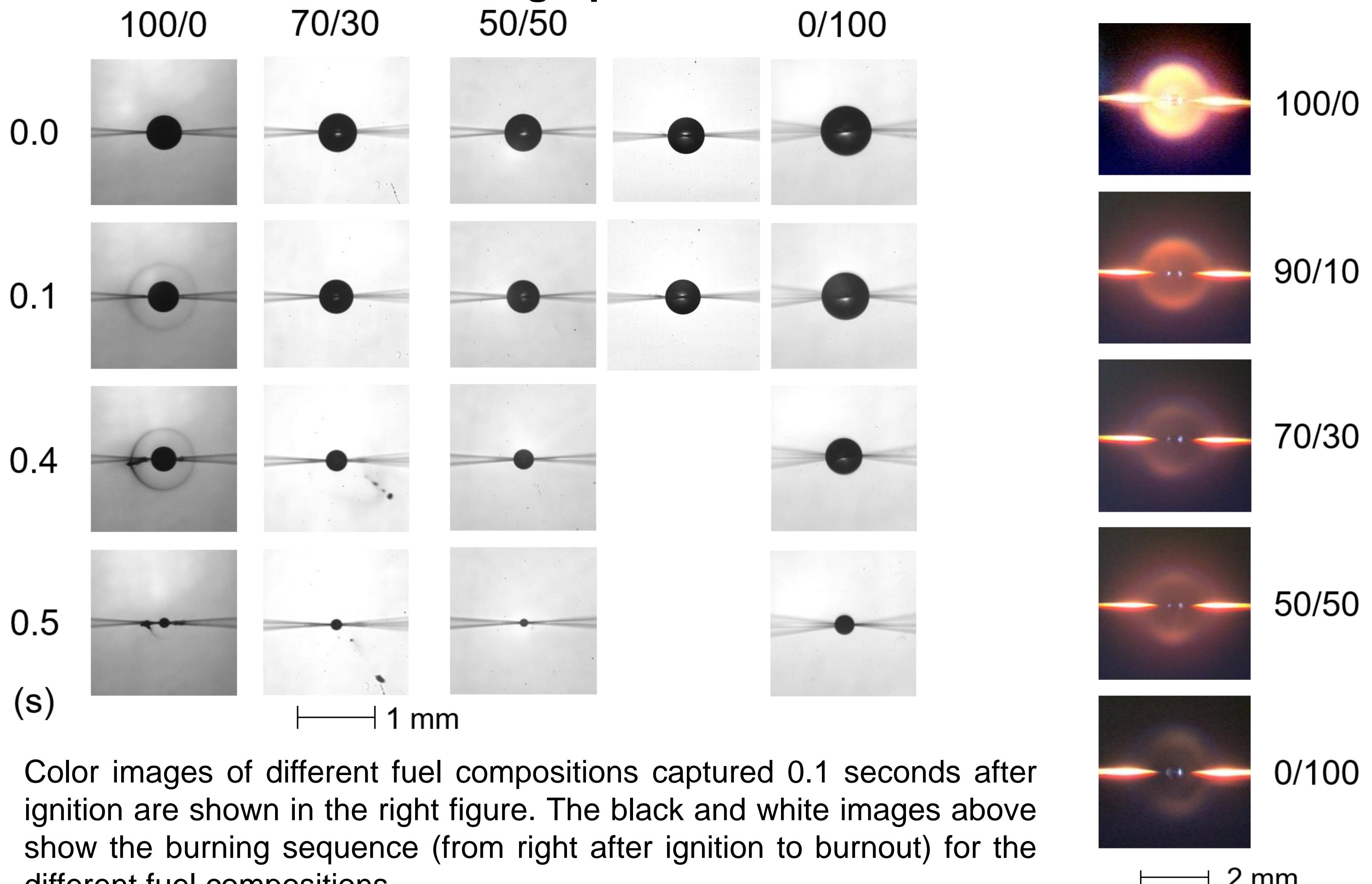
### Convectionless Environment to Promote Spherical Symmetry



### Experimental Setup

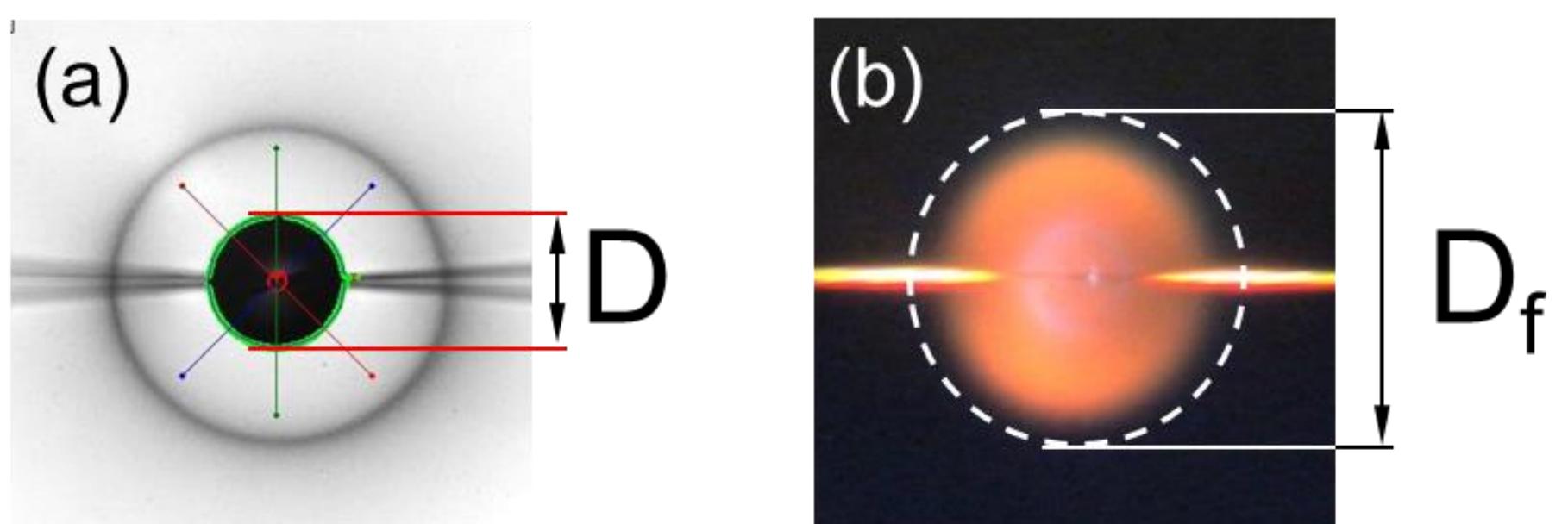


## Photographic Observations



Color images of different fuel compositions captured 0.1 seconds after ignition are shown in the right figure. The black and white images above show the burning sequence (from right after ignition to burnout) for the different fuel compositions.

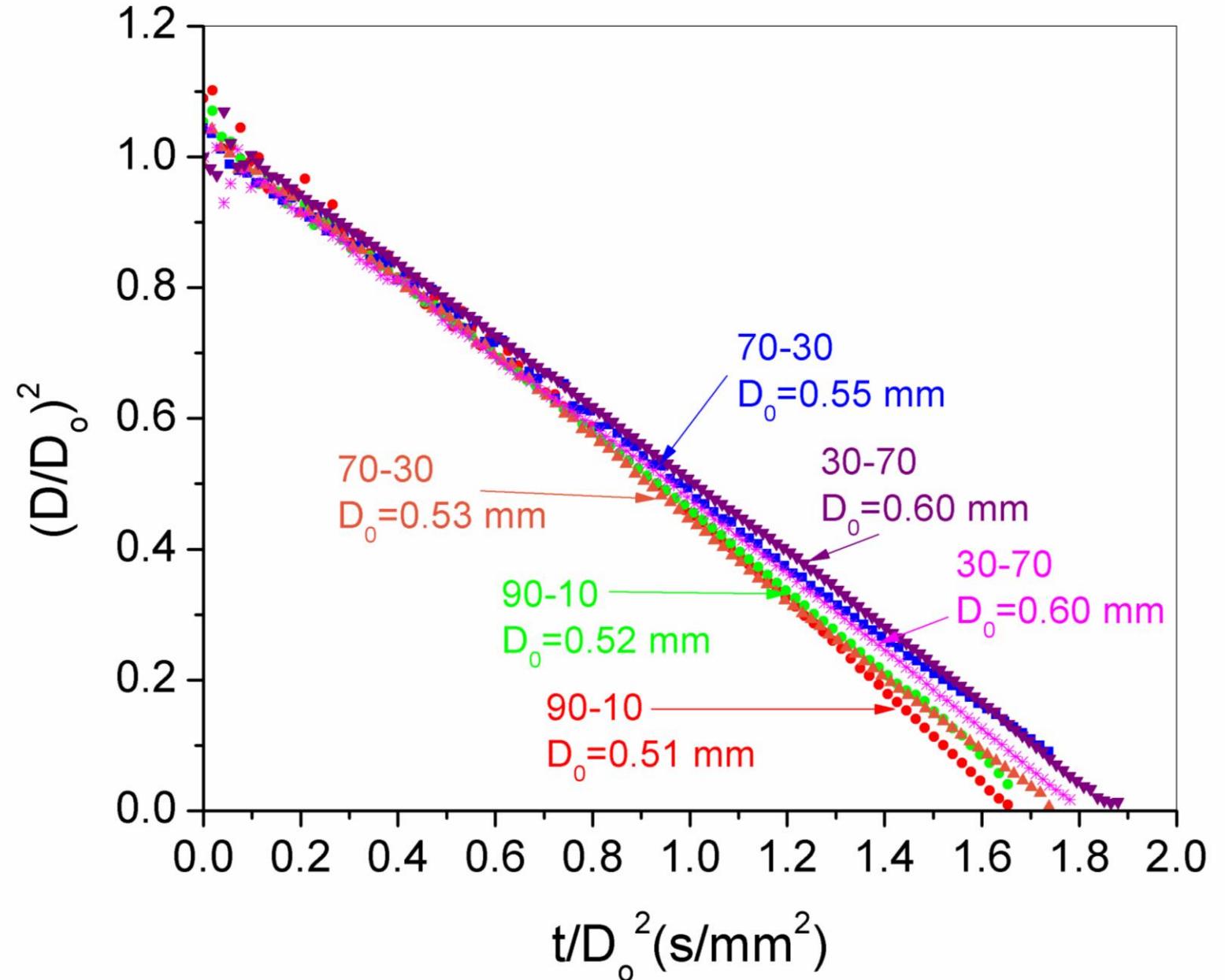
## Image Analysis



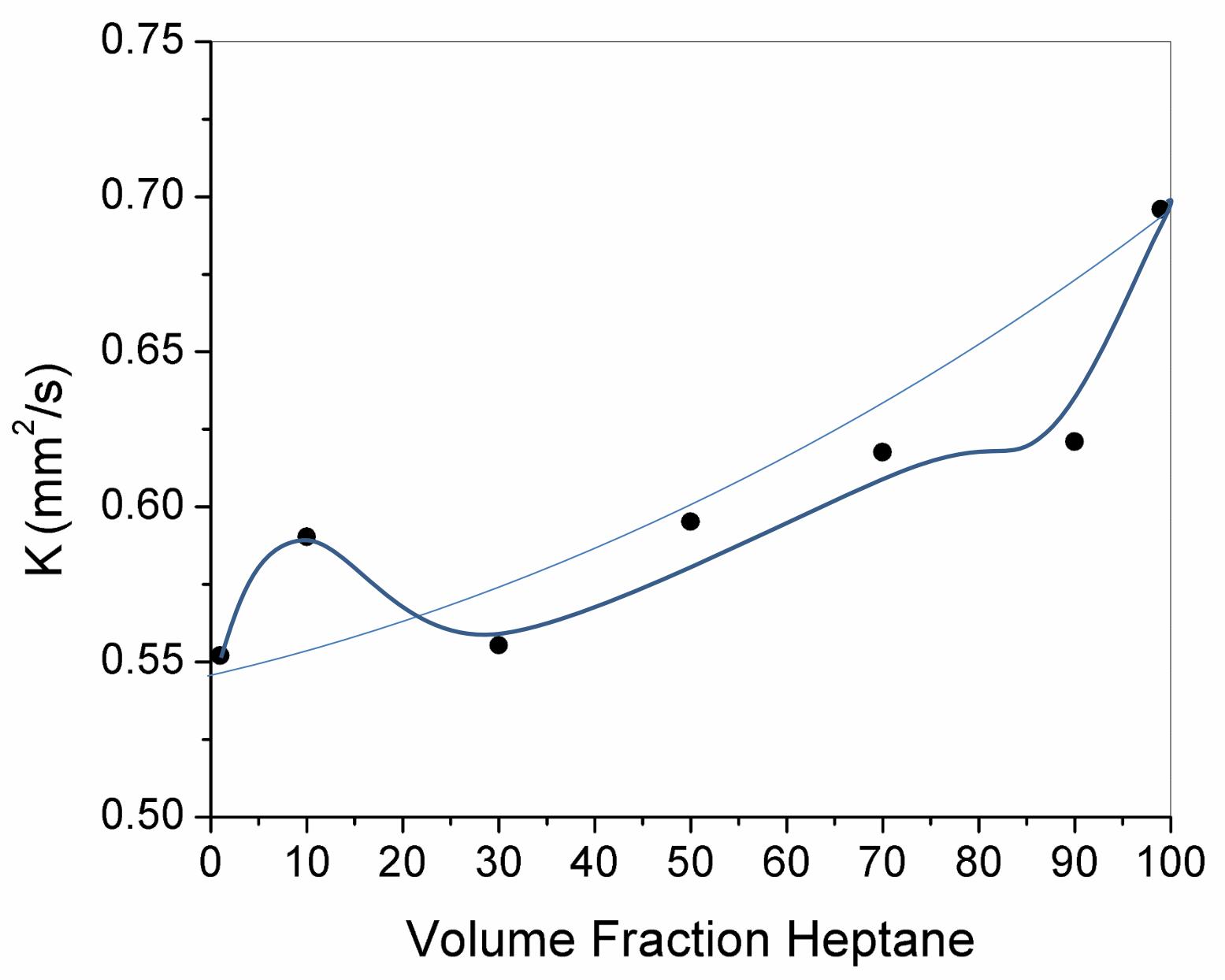
Droplet diameters figure (a) are determined from black-and-white images using automated software. Flame diameters figure (b) are manually measured from color images using the outer luminous zone and the glow of the fiber as reference.

## Quantitative Data

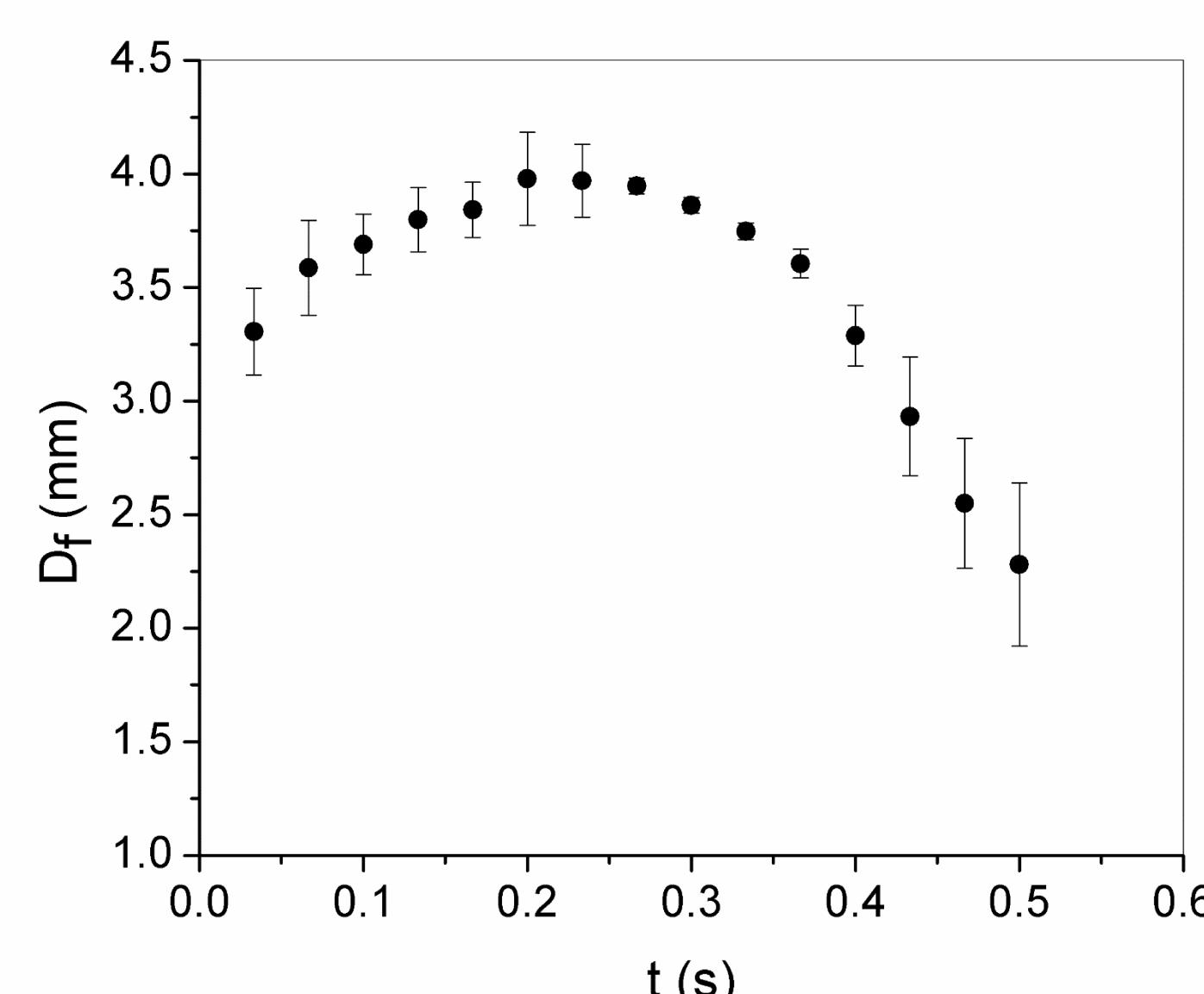
### Droplet Diameter Evolution of Different Fuel Compositions



### Burning Rates of Different Fuel Compositions



### Flame Diameter Evolution for 70-30 Heptane/Iso-butanol Fuel Composition



## Conclusions

- Diluting heptane with iso-butanol reduces sooty propensity, the burning rate, and the relative position of the flame to the droplet.
- All heptane/iso-butanol blends have linear burning rates. Burning rates vary non-linearly between compositions.

## Acknowledgements

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