

# Combustion Characteristics of Heptane/iso-Butanol Mixture Droplets

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## Background

### Blending Biofuels with Transportation Fuels

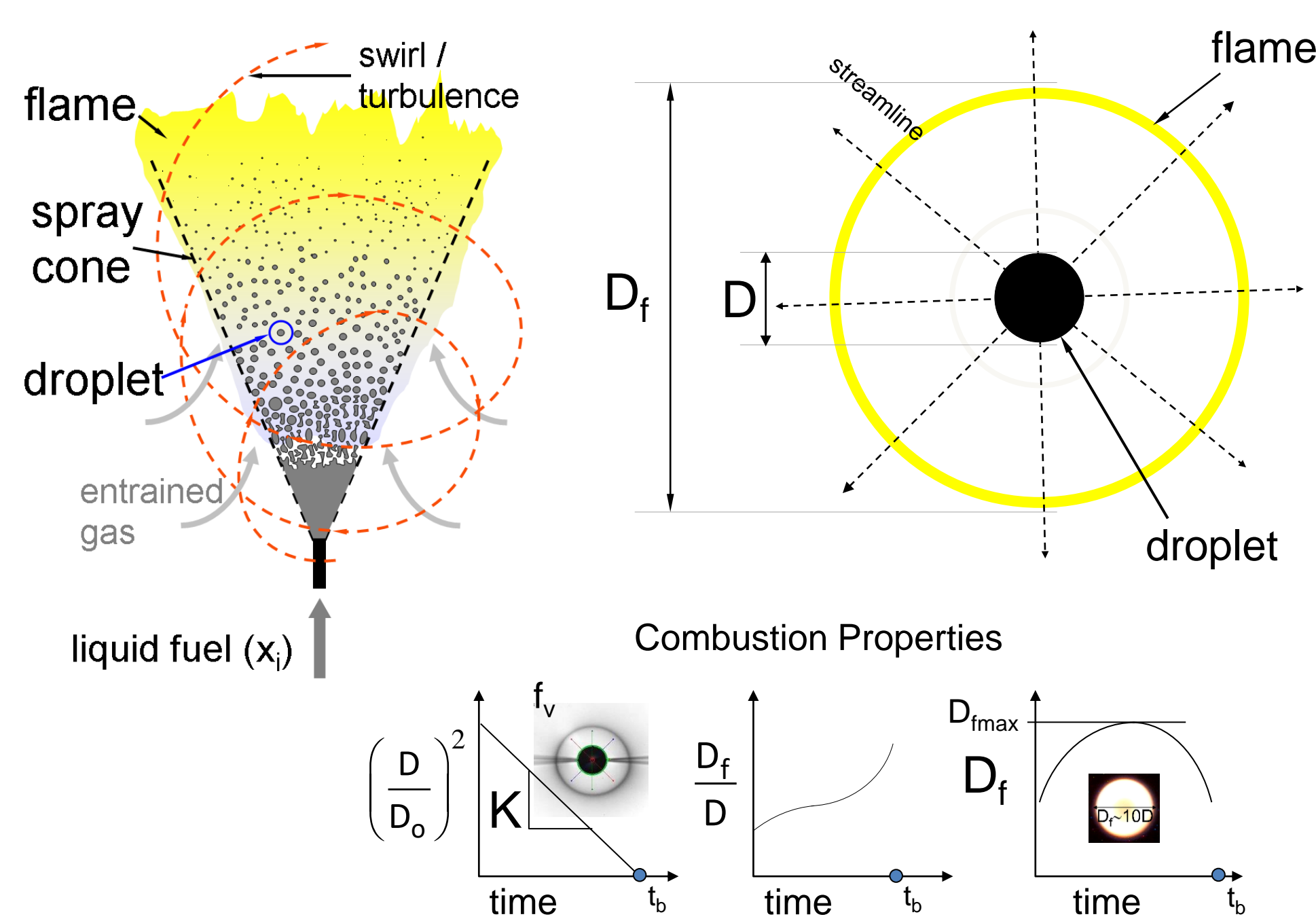
- Biofuels are fuels derived from biological feedstock (eg. ethanol from corn).
- Biofuels are actively being investigated as potential diesel fuel additives largely due to their renewability and their superior combustion properties to ethanol.
- Blending biofuels with transportation fuels can significantly 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

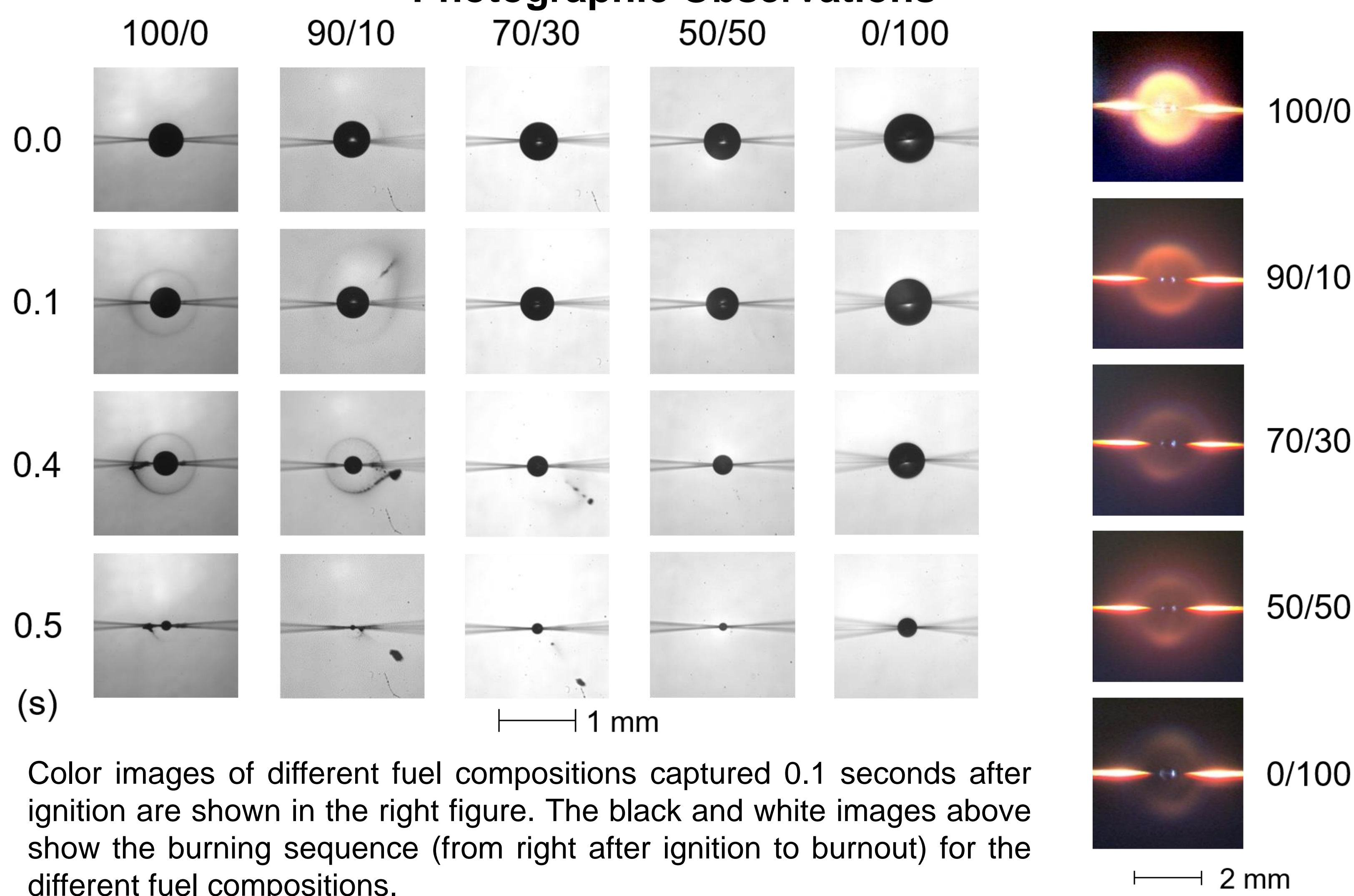
- Diesel is a multi-component fuel. Heptane (a prominent component of diesel which captures many of diesels relevant combustion characteristics) is used as a surrogate.
- Heptane is then blended in various proportions with iso-butanol, a promising biofuel, to create a two-component surrogate fuel.

### Combustion Properties from a Single Droplet

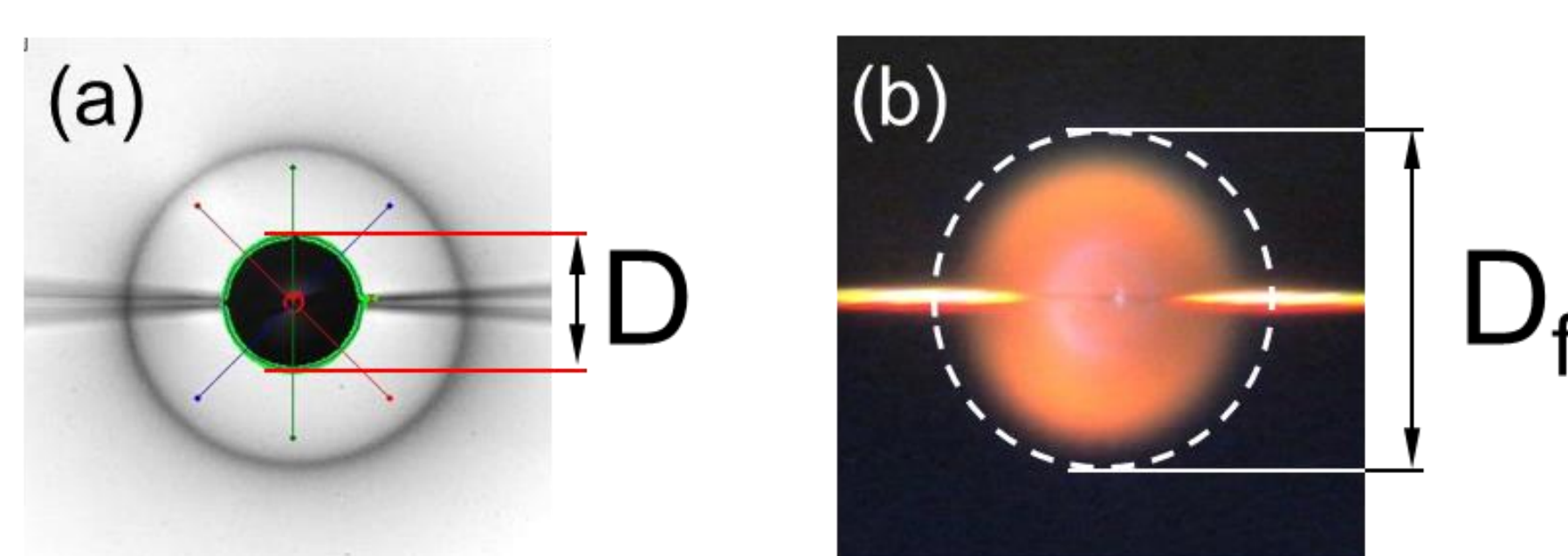
- Sprays are not well controlled environments.
- Consider only a single element of the spray: a droplet.
- Remove convection to create spherical symmetry.
- Extract combustion properties.



## Photographic Observations

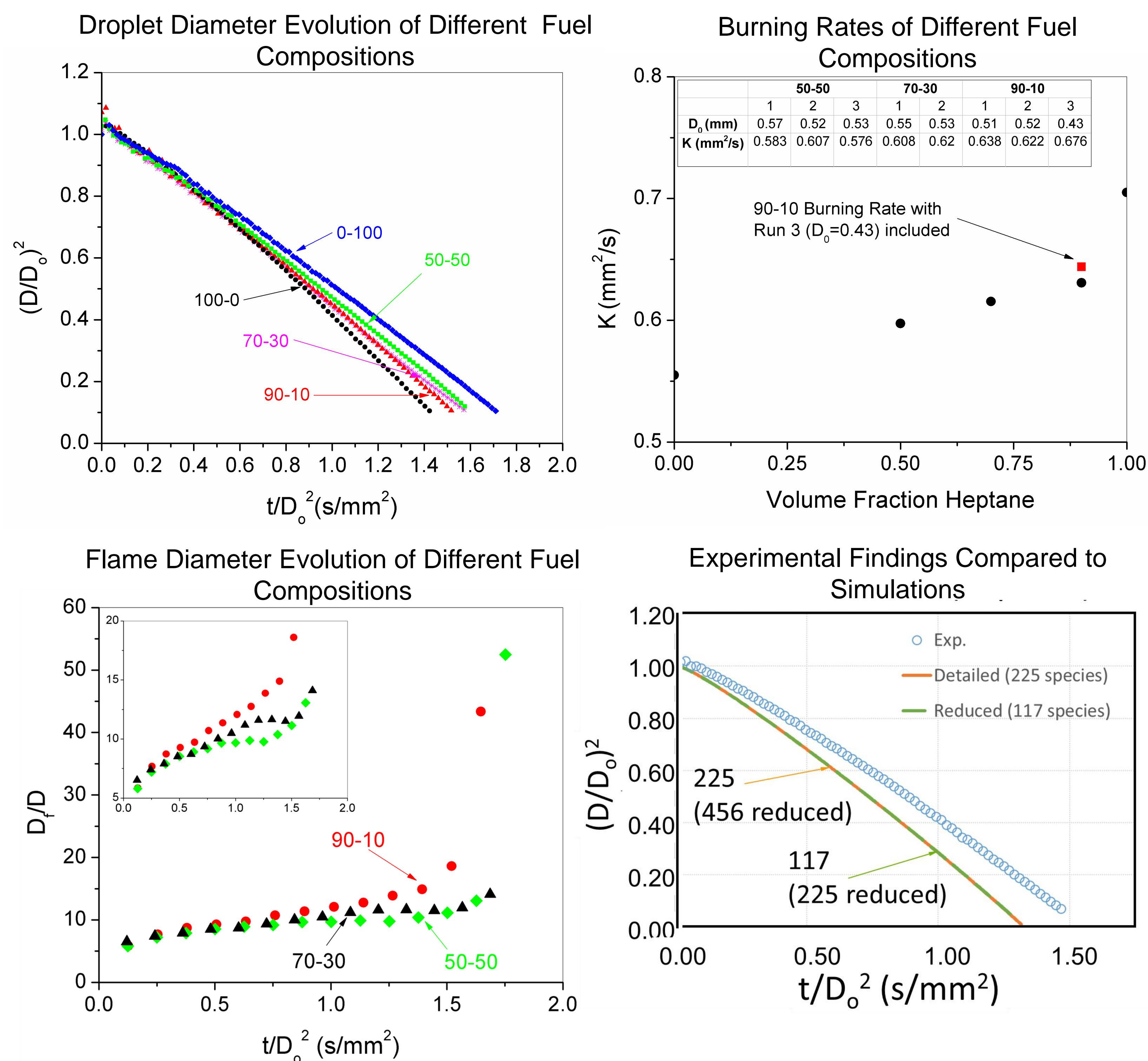


## Image Analysis

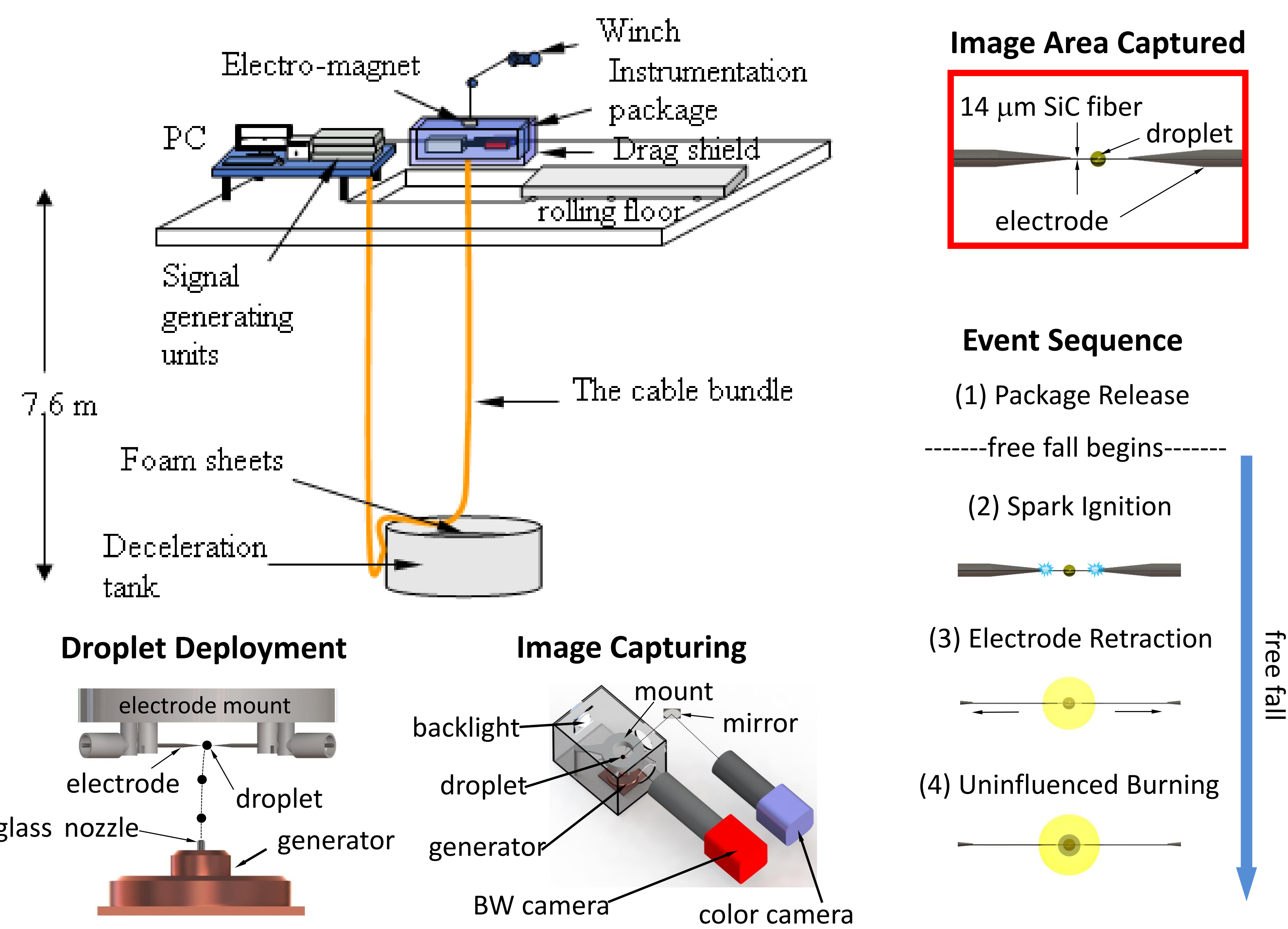


Droplet diameters figure (a) are determined from black-and-white images using automated software. Flame diameters figure (b) are manually measured from color images using the outer luminous zone and the glow of the fiber as reference.

## Quantitative Data

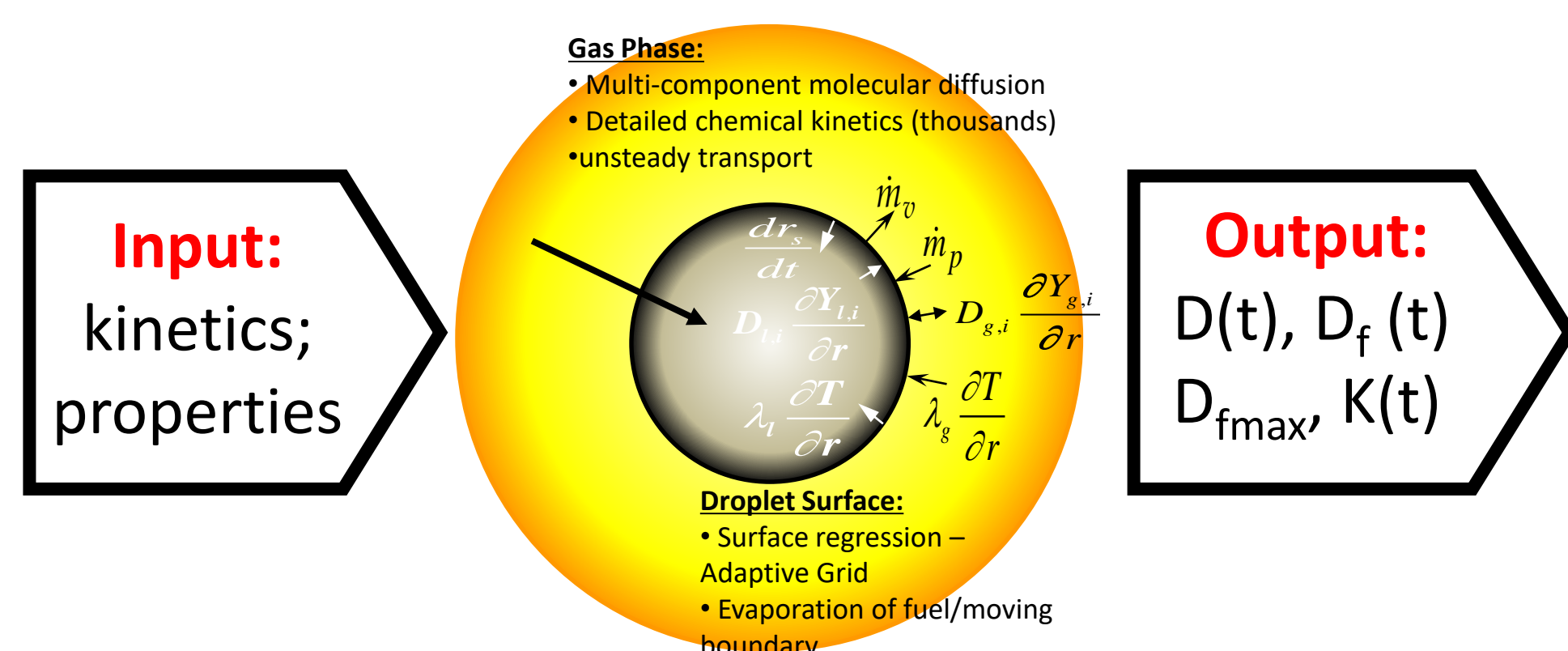


## Convectionless Environment to Promote Spherical Combustion



## Detailed Numerical Model

Evaluate Kinetics: detailed  $\rightarrow$  reduced



- Data gathered from experiments are used as a benchmark for detailed numerical modelers.
- Modelers attempt to replicate experimental results using a detailed reaction mechanism.
- That detailed reaction mechanism is then reduced to a smaller set of reactions that continues to emulate the experimentally observed phenomena.

## Conclusions

- Diluting heptane with iso-butanol reduces the overall sooting propensity, the burning rate, and the ratio between the flame and droplet diameters.
- All heptane/iso-butanol blends have linear burning rates. Burning rates vary non-linearly between compositions.
- Comparison with detailed numerical model is in progress.

## Acknowledgements

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