

Impact of DMF on Engine Performance and Emissions as a New Generation of Sustainable Biofuel

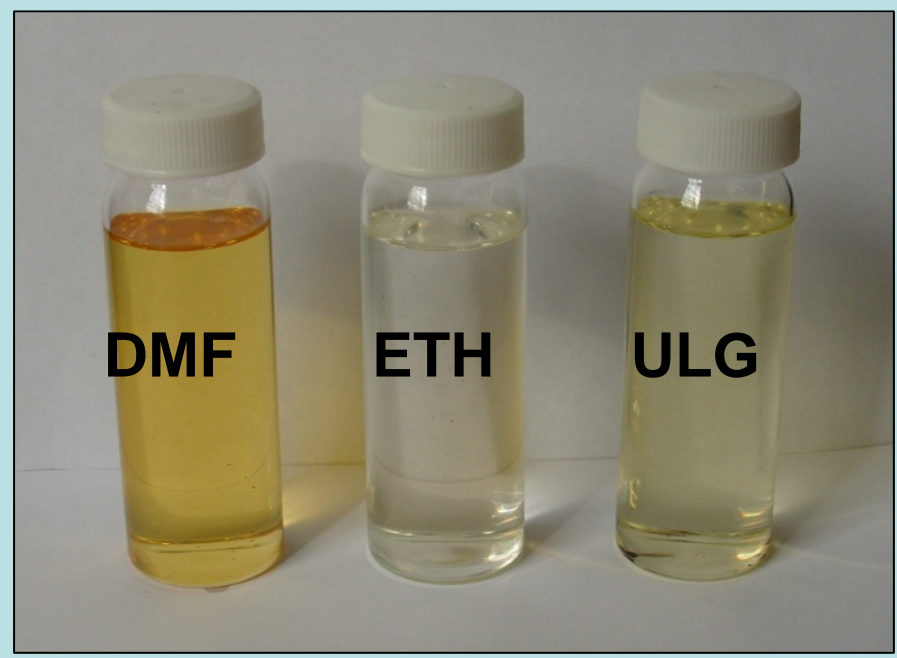
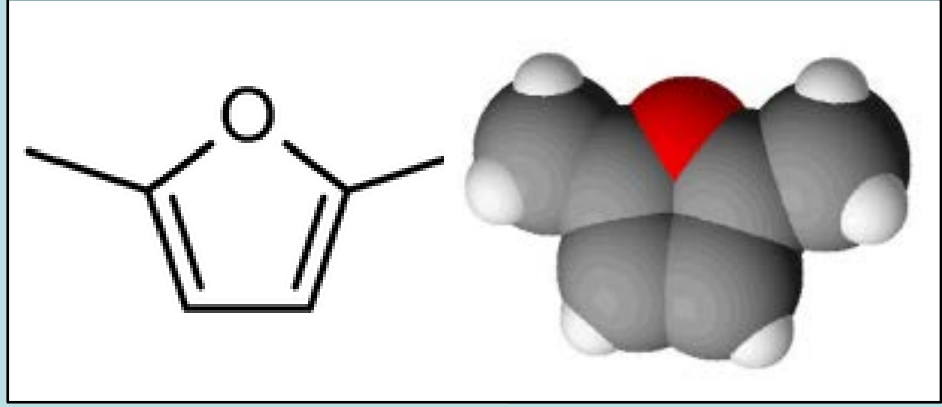
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Introduction

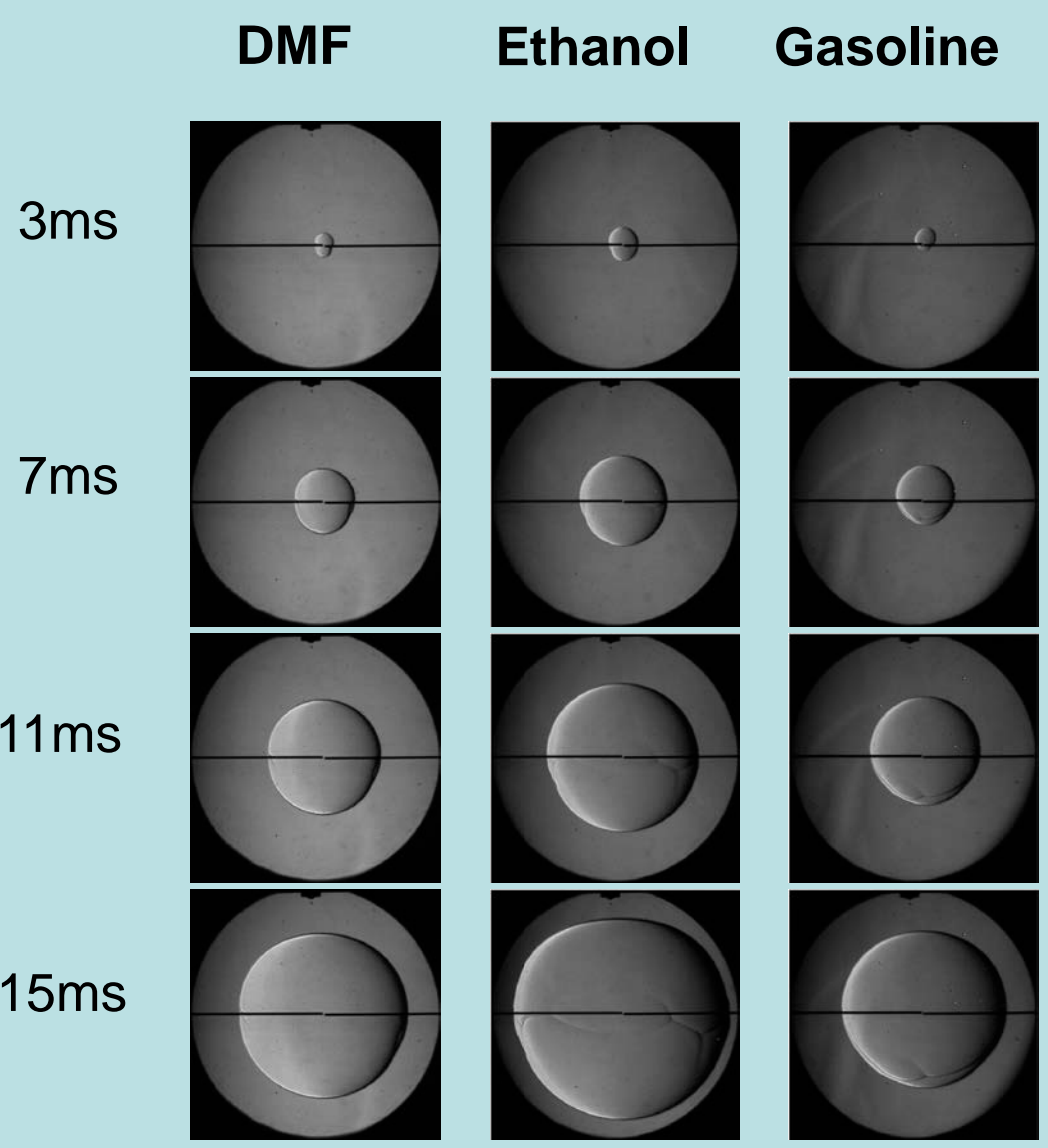
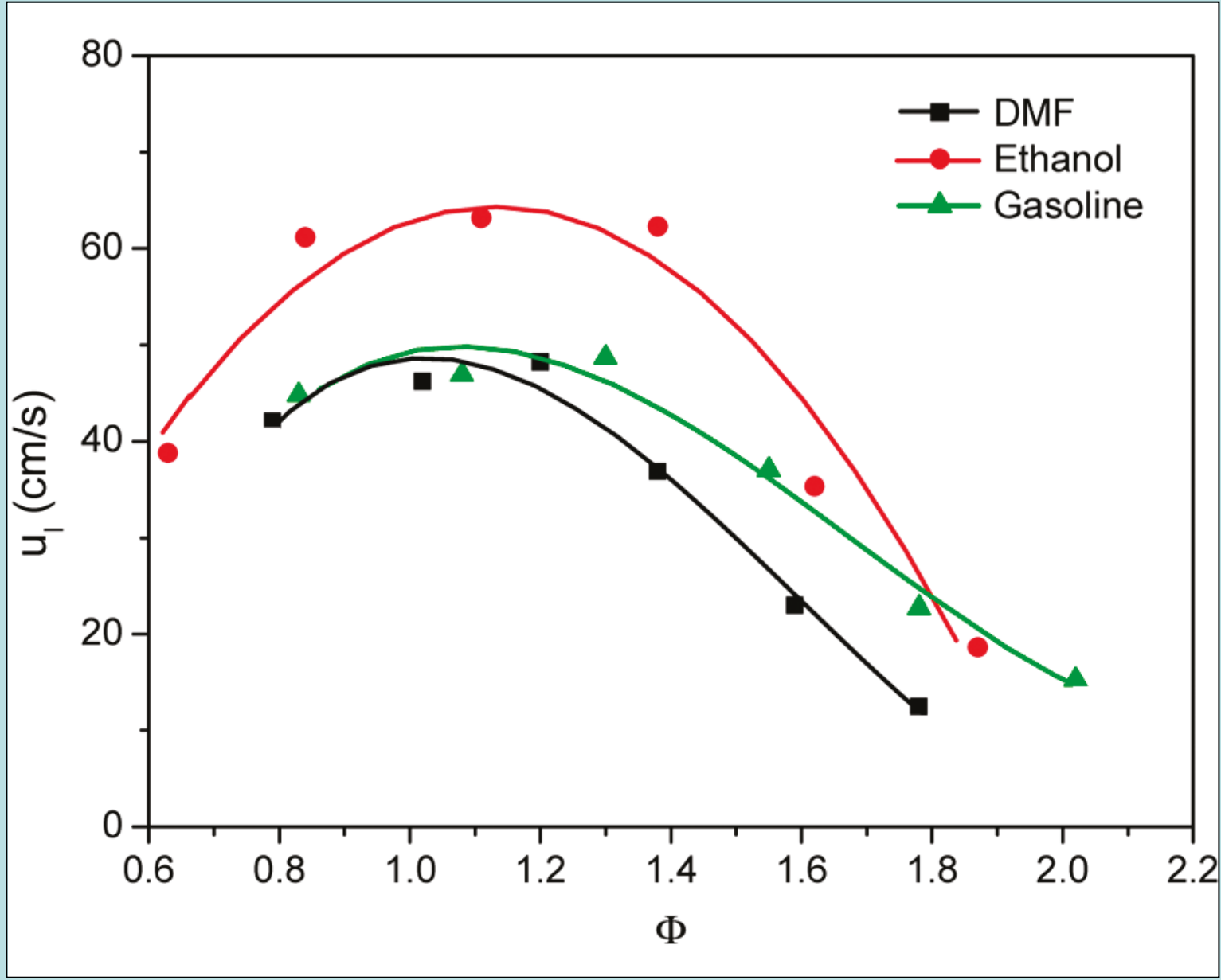
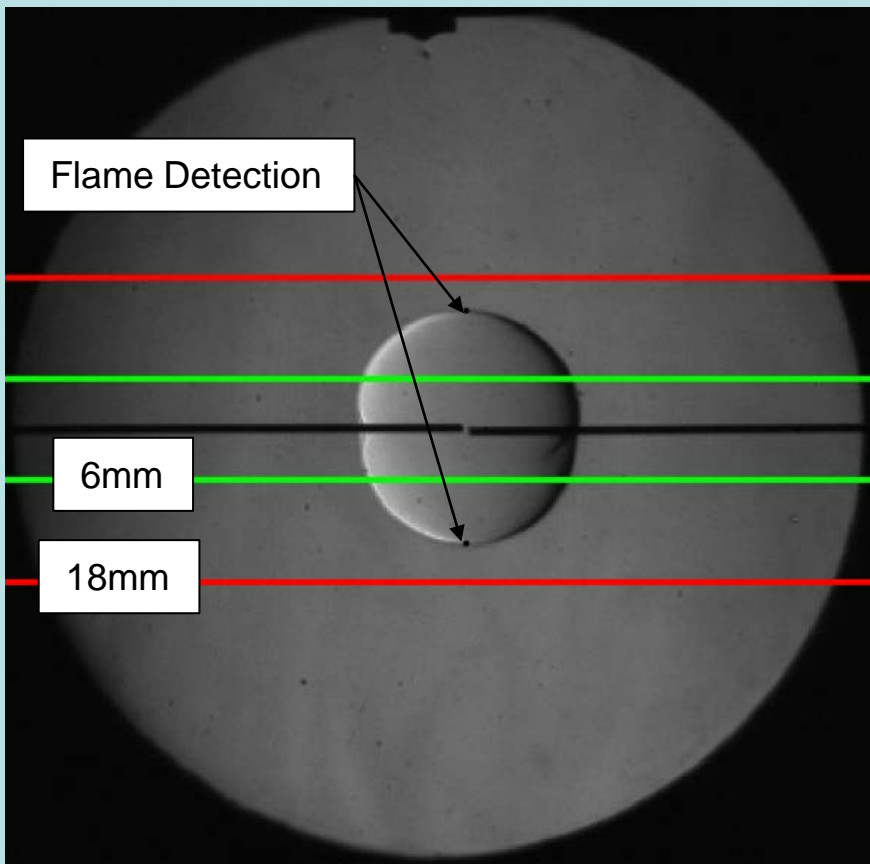
- Biofuels help to reduce dependency on gasoline (ULG).
- Short- to mid-term solution for solving the concerns of global warming.
- Bioethanol (ETH) is widely used in Europe and America, but has many disadvantages.
- 2,5-dimethylfuran (DMF) is a promising biofuel: high energy density.

Structure of DMF



Laminar Burning Velocity

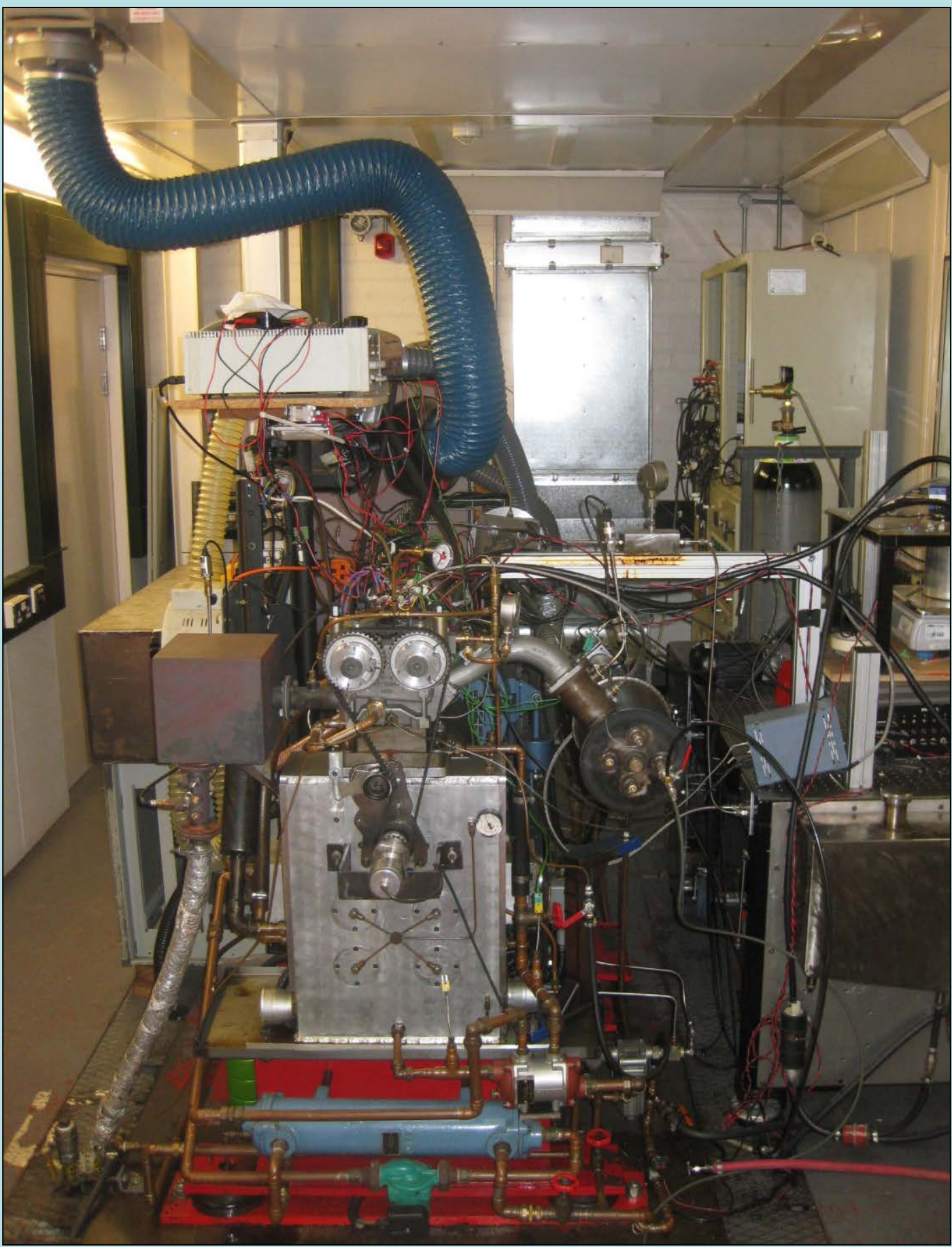
- Physicochemical property of a combustible mixture.
- An important parameter developed to describe such combustion phenomena as the ignition energy and flame stability.
- It affects the fuel burning rate in internal combustion engines and therefore the engine's efficiency and emissions.
- It is an intrinsic property of a combustible mixture and is widely used to validate the kinetic mechanism.



Thermal Engine Testing

- Thermal engine is used to examine combustion and emissions performance using a variety of instruments.
- Cylinder head is taken from a Jaguar V8 production engine.
- Variable Valve Timing (VVT) technology is available.
- Can be run in spark-ignition (SI) mode or homogenous charge compression ignition (HCCI) mode.

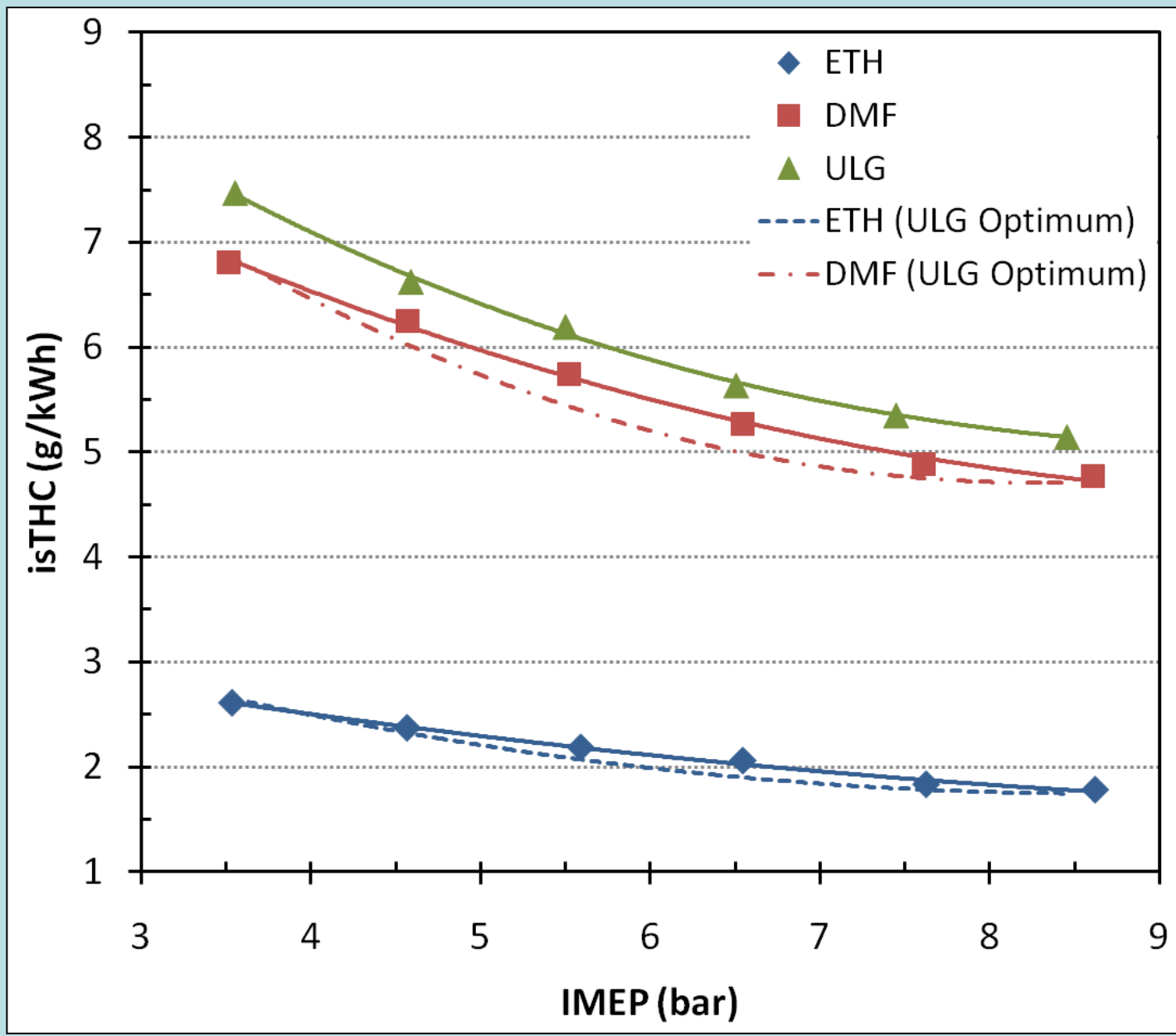
Single Cylinder Thermal Engine



Fuel Injector



Hydrocarbon Emissions

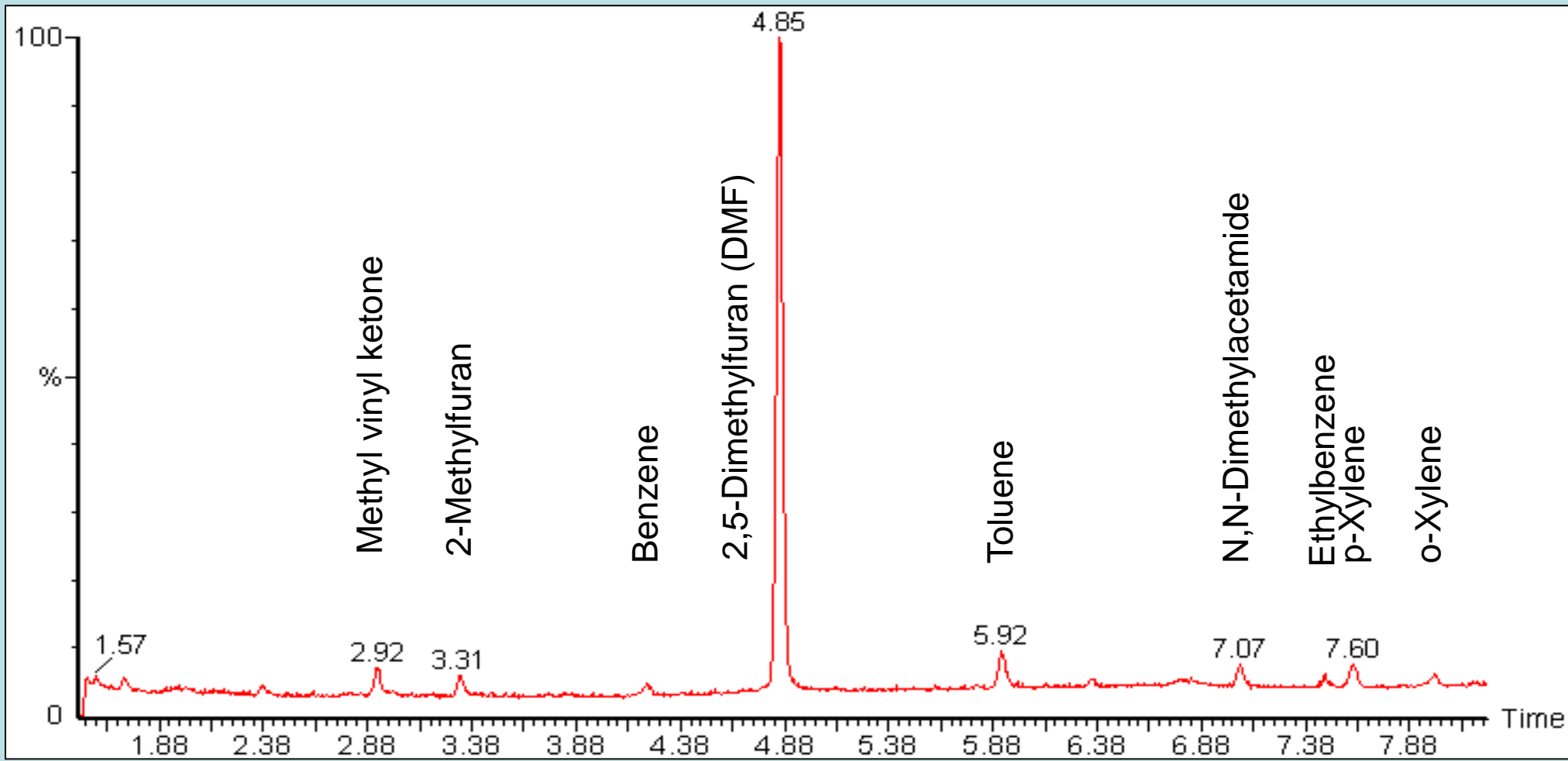


Hydrocarbon Emissions Speciation

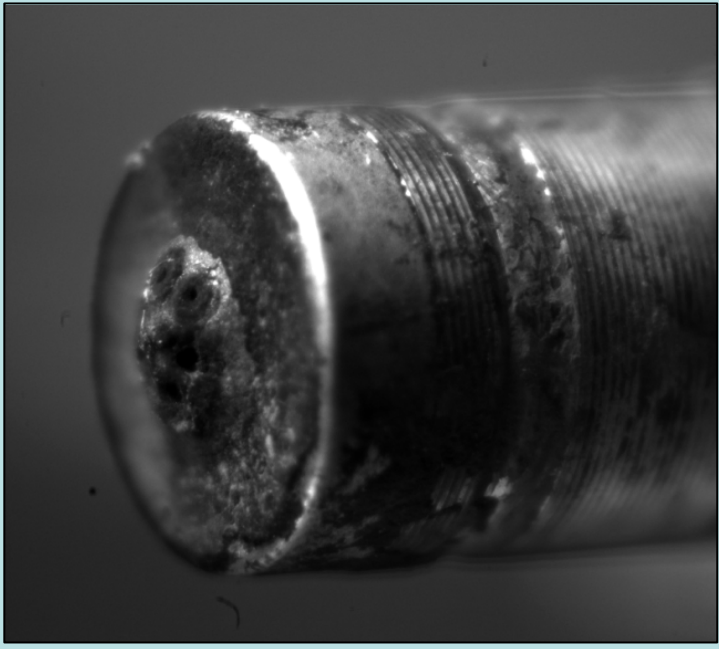
Perkin Elmer GC-MS



Chromatogram of DMF Exhaust at 3.5bar IMEP



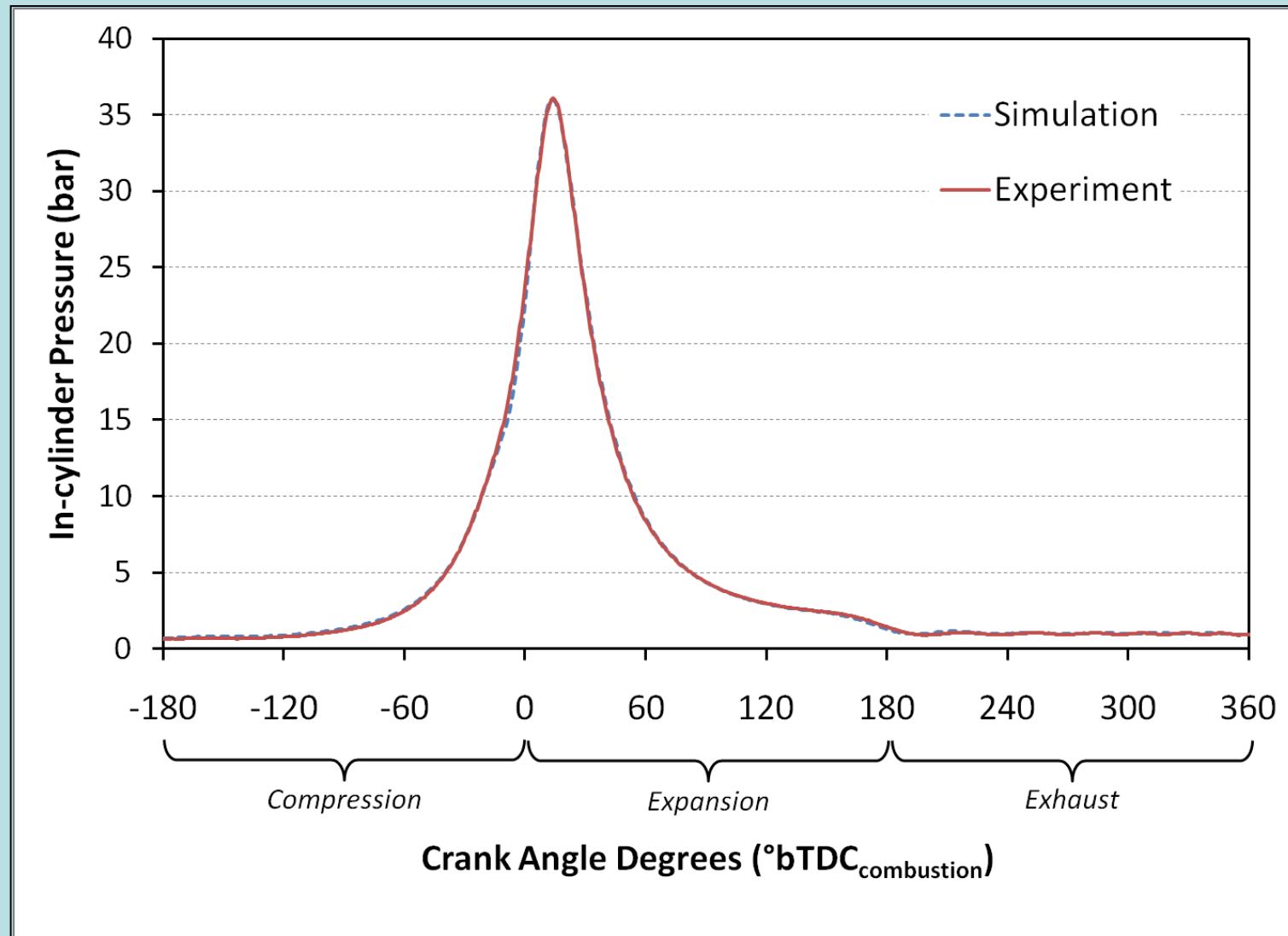
Injector Tip Deposits



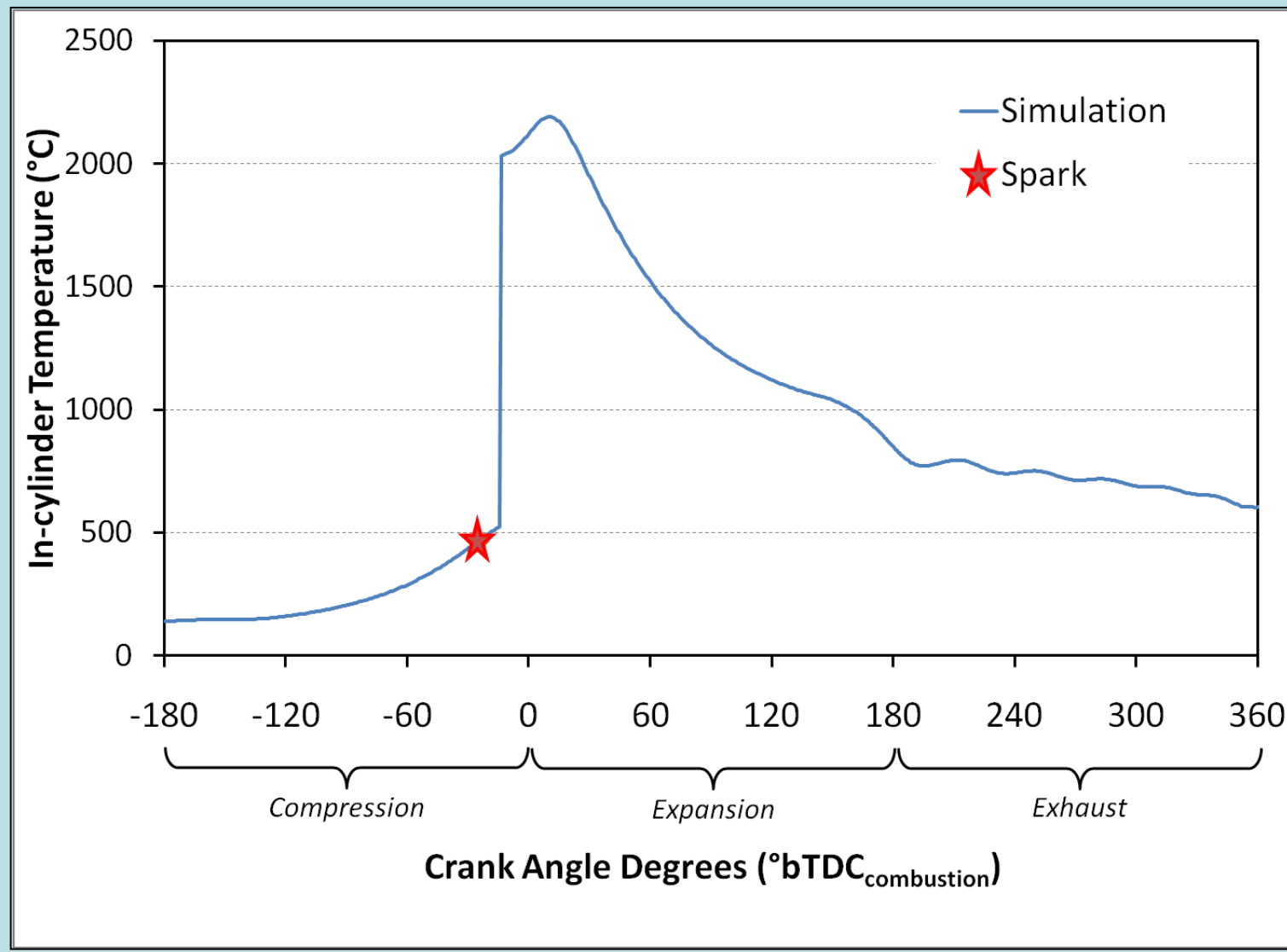
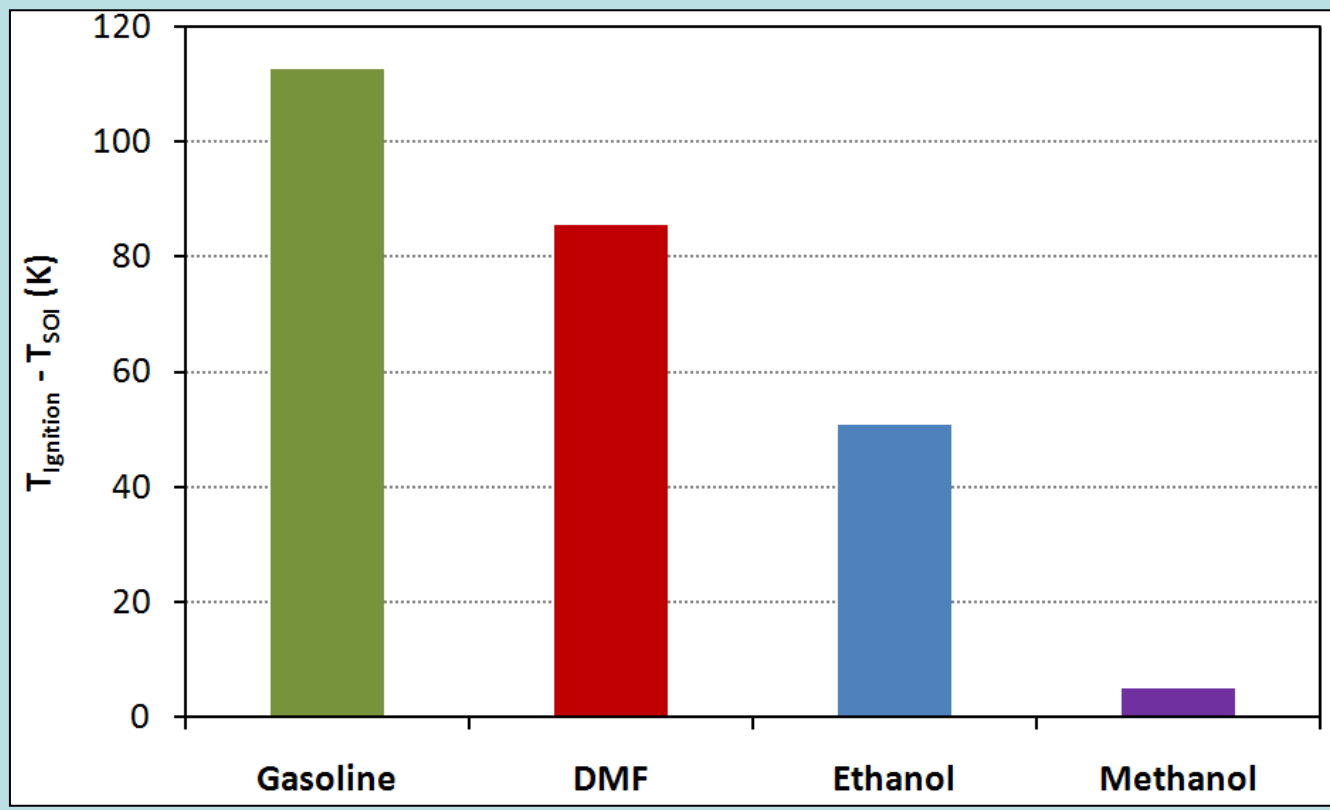
Engine Simulation

- Combustion model developed using combustion theory.
- Highly accurate match to combustion pressure history.
- Predict in-cylinder temperature and emissions.
- Quantify the charge-cooling effect of fuels.
- Examine effect of VVT and different fuels.

Simulation Results



Charge-cooling Effect



Publications

- Combustion and Emissions of 2,5-Dimethylfuran in a Direct-Injection Spark-Ignition Engine** Shaohua Zhong, Ritchie Daniel, Hongming Xu, Jun Zhang, Dale Turner, Miroslaw L. Wyszynski and Paul Richards. Energy and Fuels, 2010, 24(5), pp 2891-2899.
- Laminar Burning Velocities of 2,5-Dimethylfuran Compared with Ethanol and Gasoline** Guohong Tian, Ritchie Daniel, Haiying Li, Hongming Xu, Shijing Shuai and Paul Richards. Energy and Fuels, 2010, 24(7), pp 3898-3905.
- Effect of Spark Timing and Load on a DISI Engine Fuelled with 2,5-Dimethylfuran** Ritchie Daniel, Guohong Tian, Hongming Xu, Miroslaw L. Wyszynski, Xuesong Wu and Zuohua Huang. Fuel, 2011, 90(2), pp 449-458.
- Dual-injection: The Flexible, Bi-fuel Concept for Spark-ignition Engines Fuelled with various Gasoline and Biofuel Blends** Xuesong Wu, Ritchie Daniel, Guohong Tian, Hongming Xu, Zuohua Huang and Dave Richardson. Applied Energy, 2011, Article In Press.