

Fuel Design Approach for Low Emission in Engine Systems

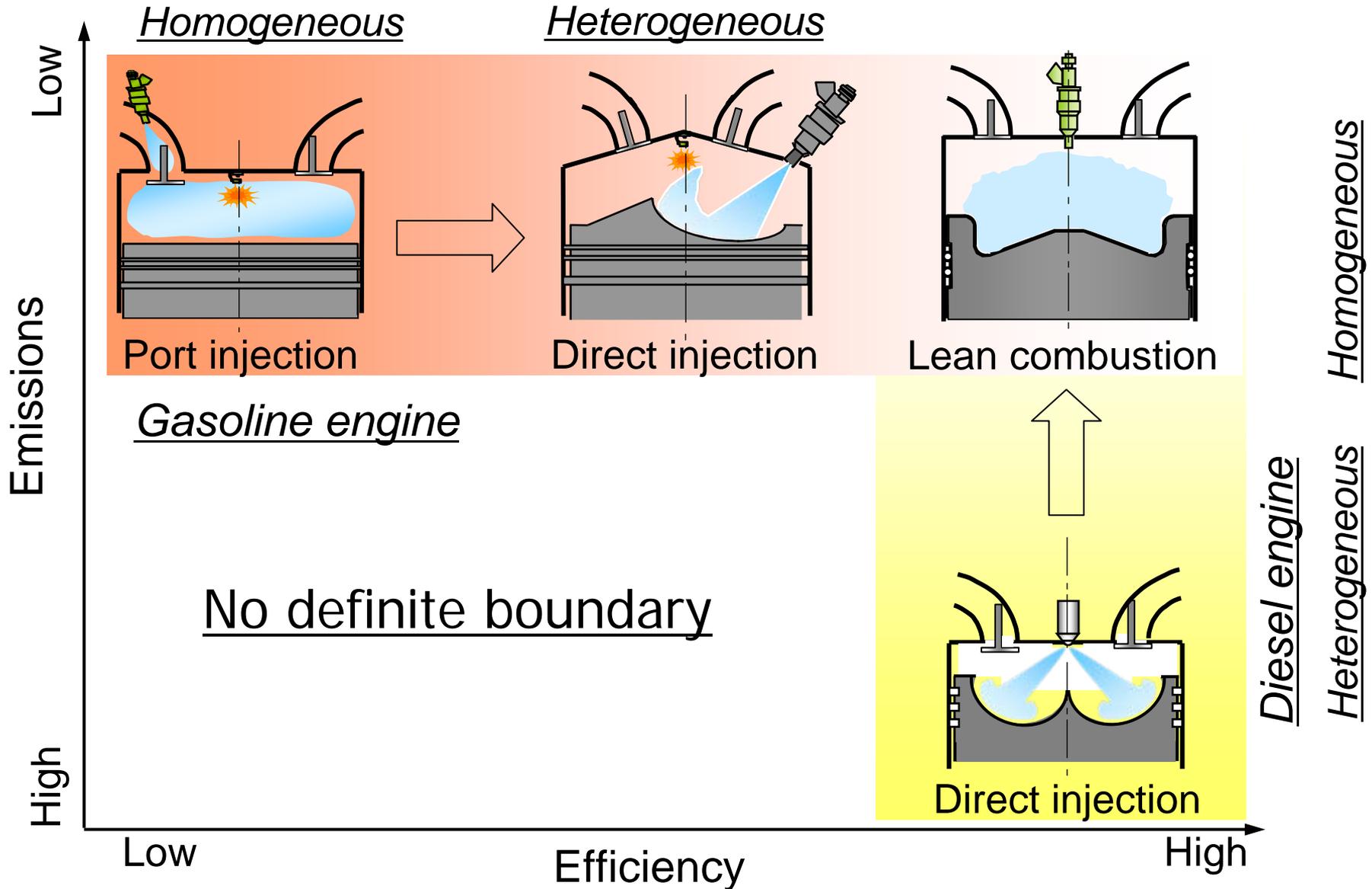
- Application of Flash Boiling Spray into HCCI -

H. Gen Fujimoto, Y. Wada, J. Senda

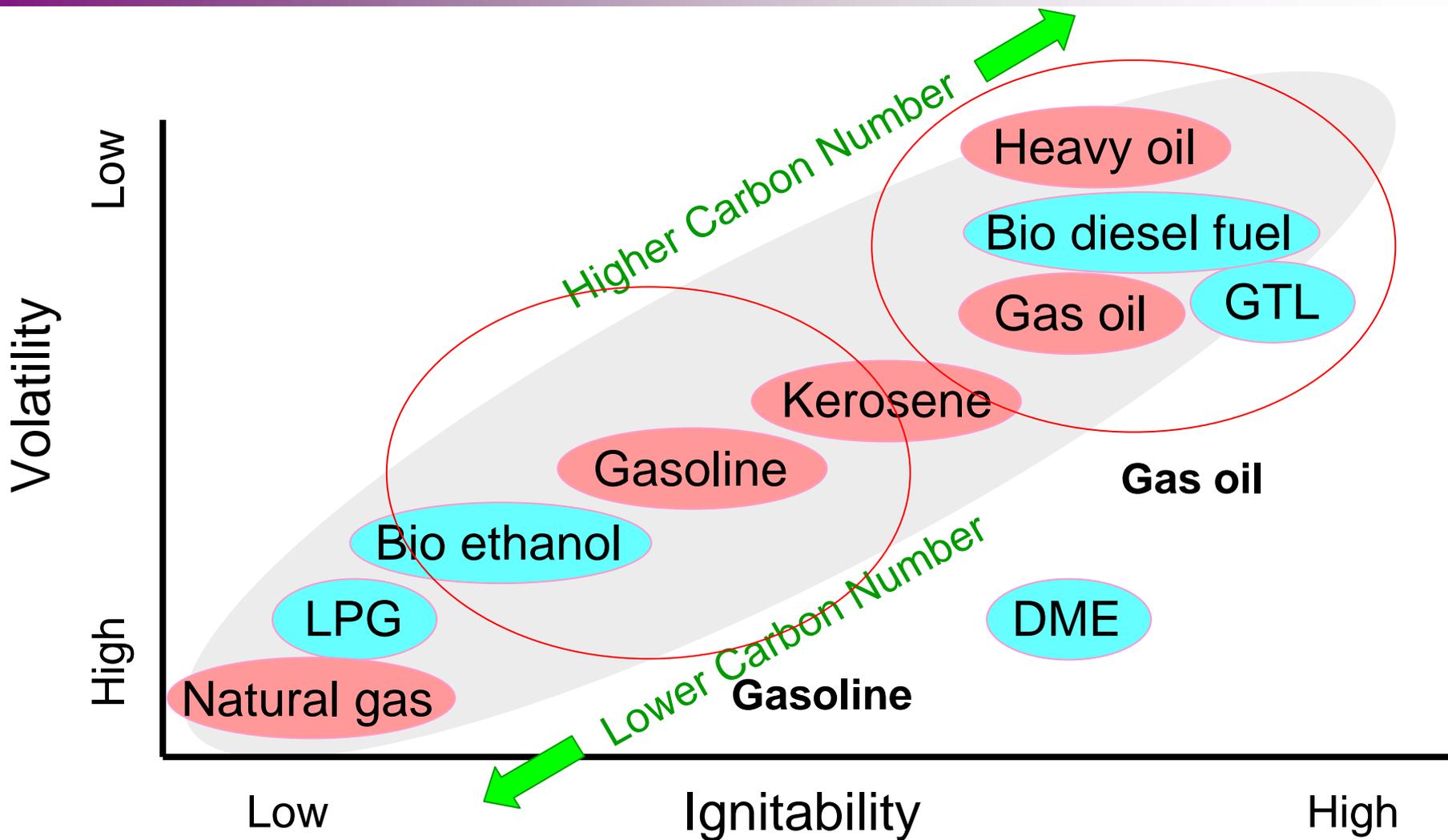
Department of Mechanical Engineering, Doshisha University

IEA TLM Meeting in Heidelberg (13-16 Aug. 06)

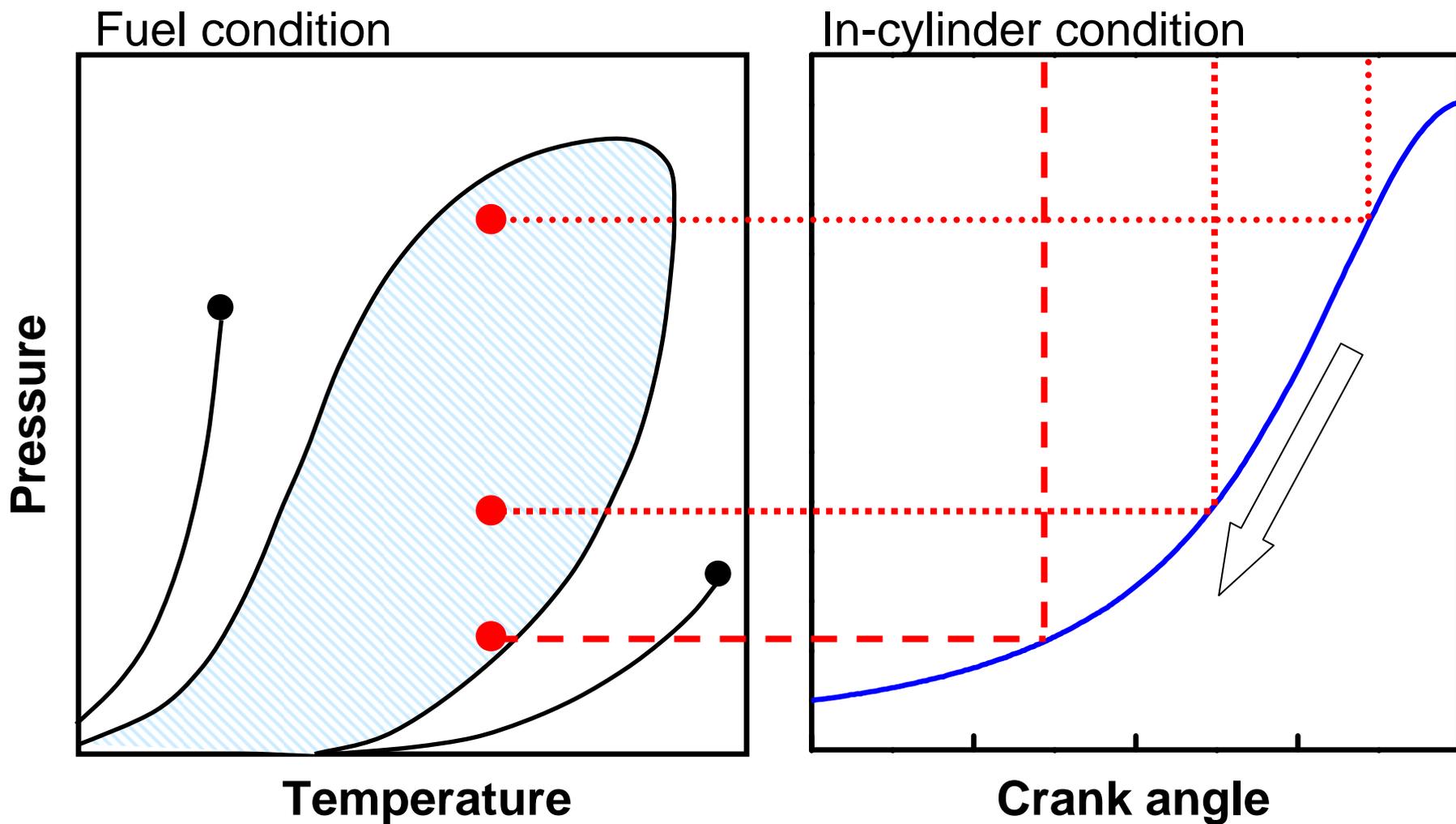
Introduction



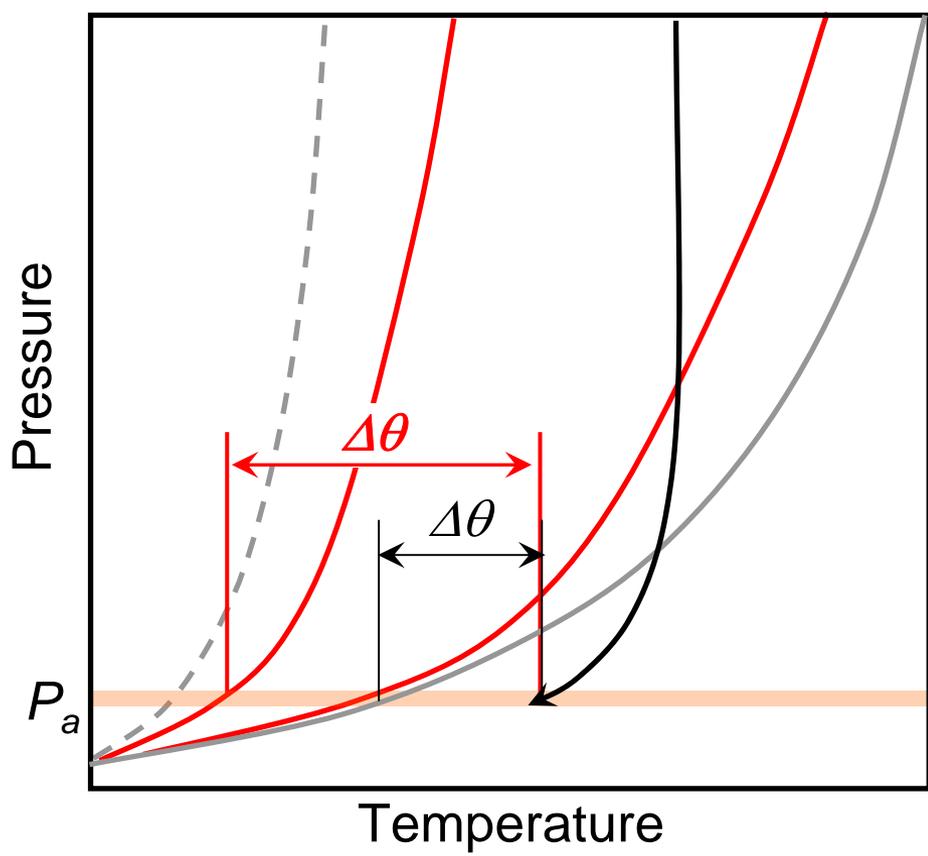
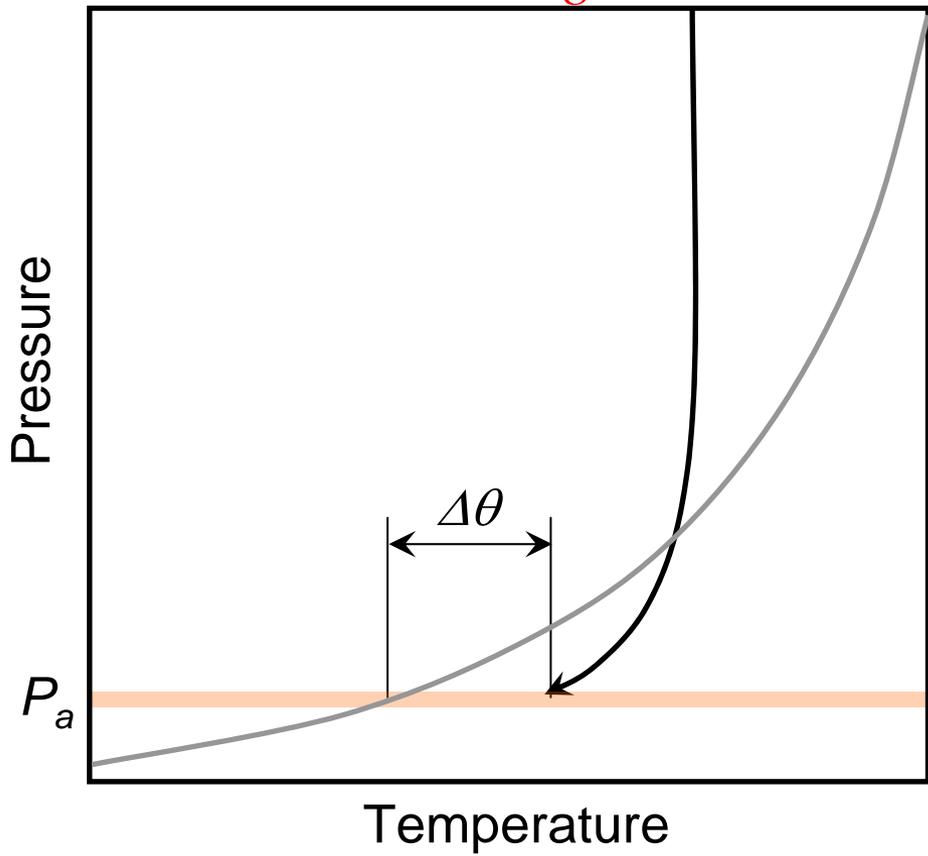
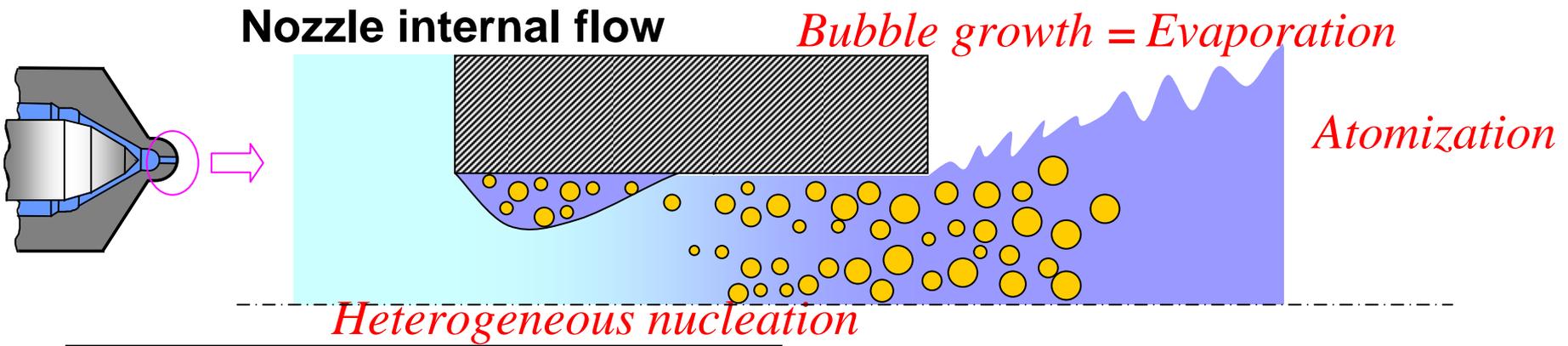
Physical and Chemical Characteristics of Conventional and Alternative Fuels



Comparison between Fuel and In-Cylinder Condition

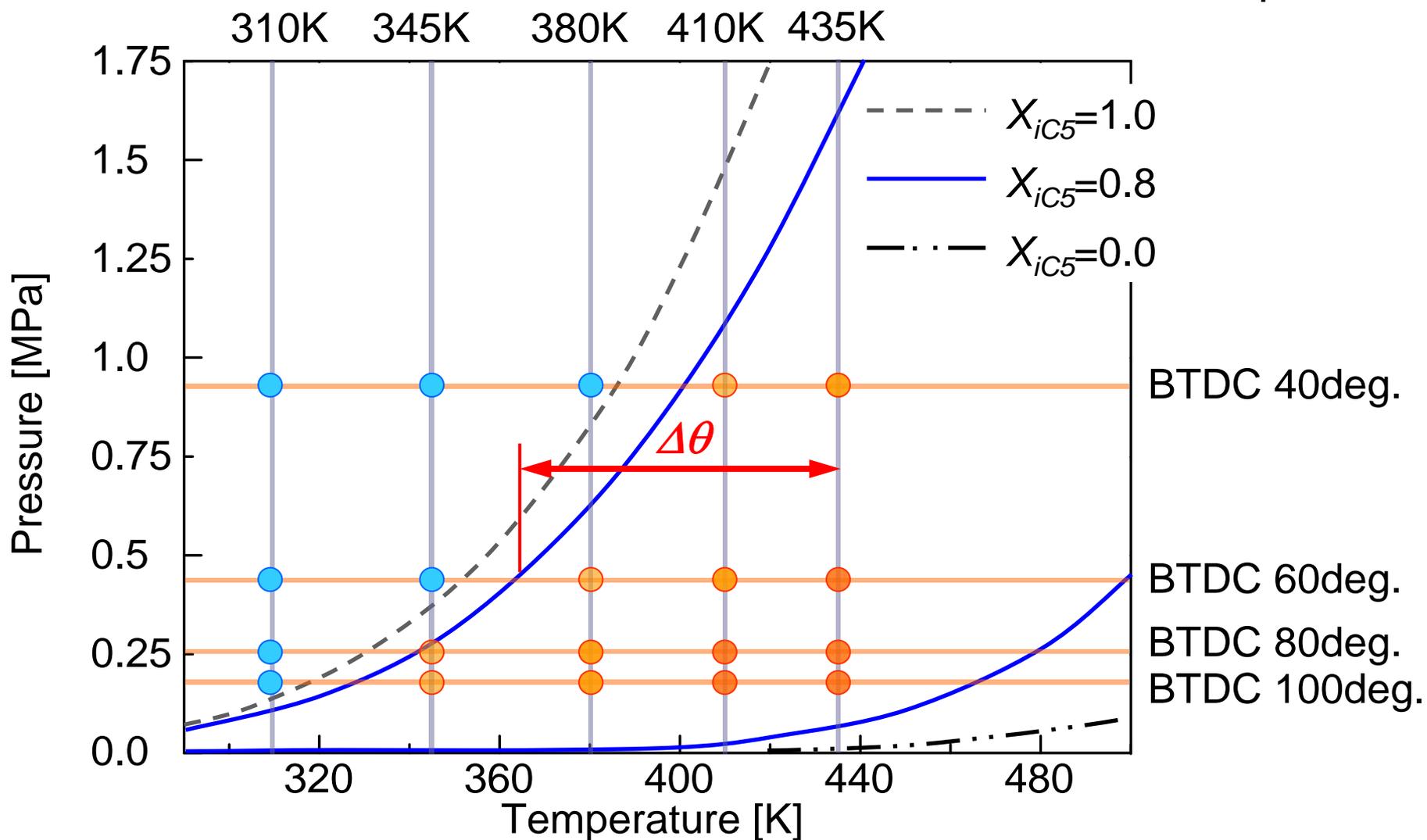


Flash Boiling

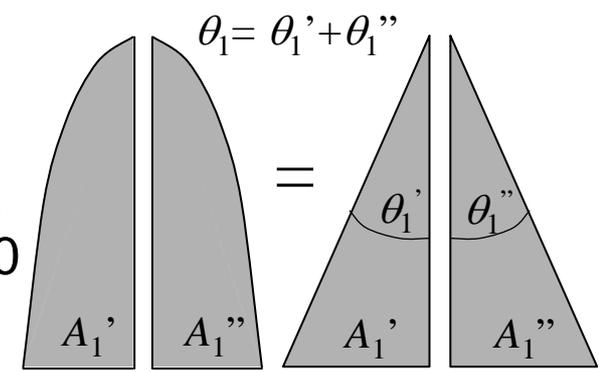
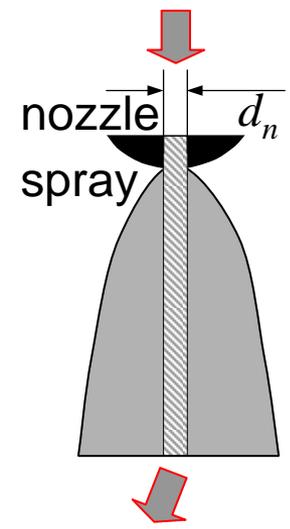
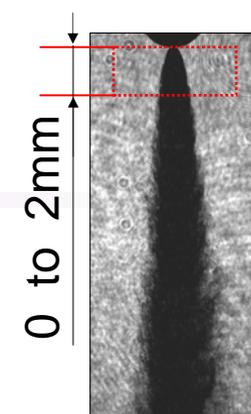
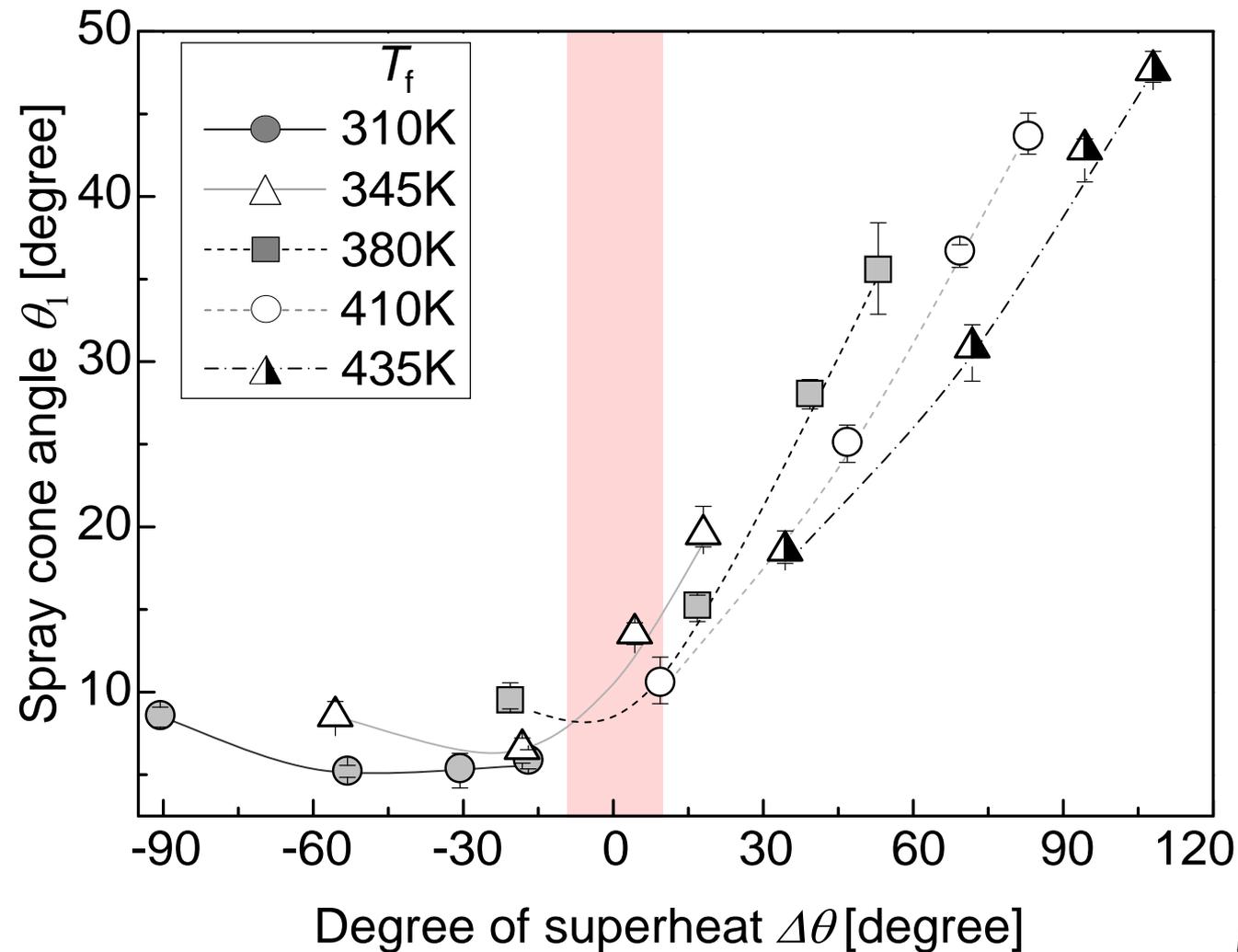


Experimental Conditions Plotted on Pressure-Temperature Diagram

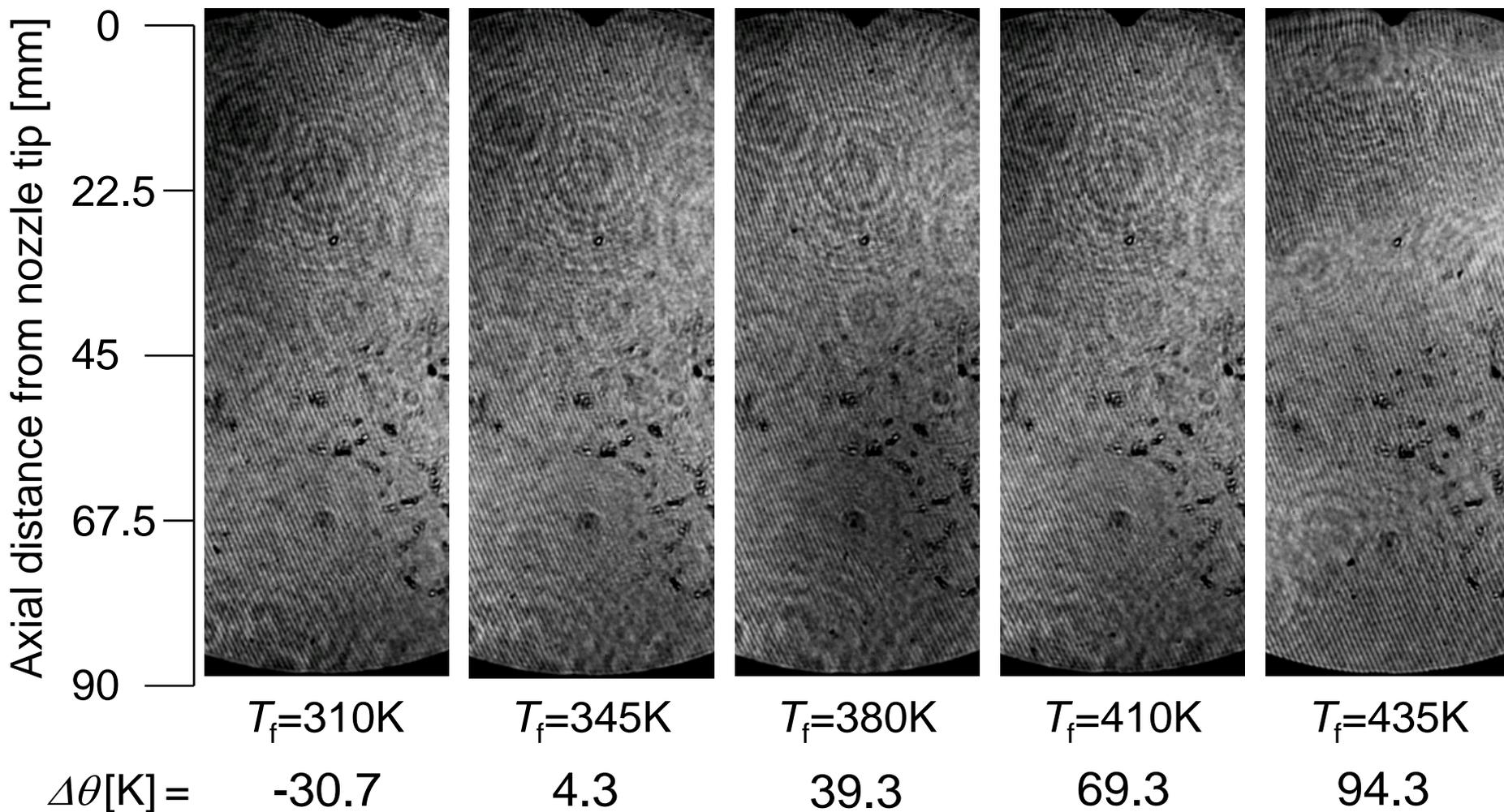
Test fuel : n-tridecane + i-pentane



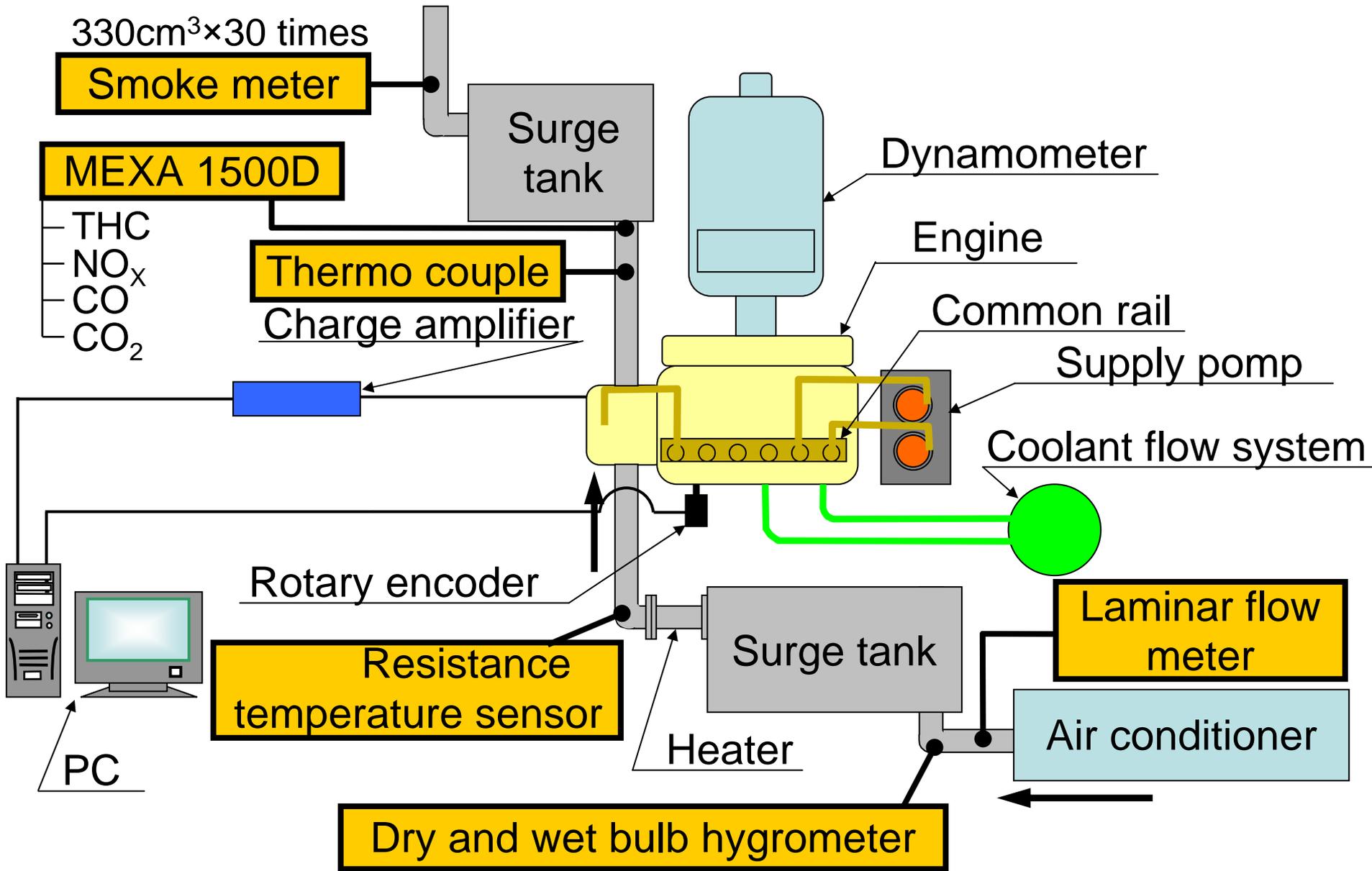
Spray Cone Angle as a Function of Degree of Superheat



Spray Images for each Initial Fuel Temp. (Simulated Crank Angle = BTDC80deg.)



Schematic Diagram of Test Engine

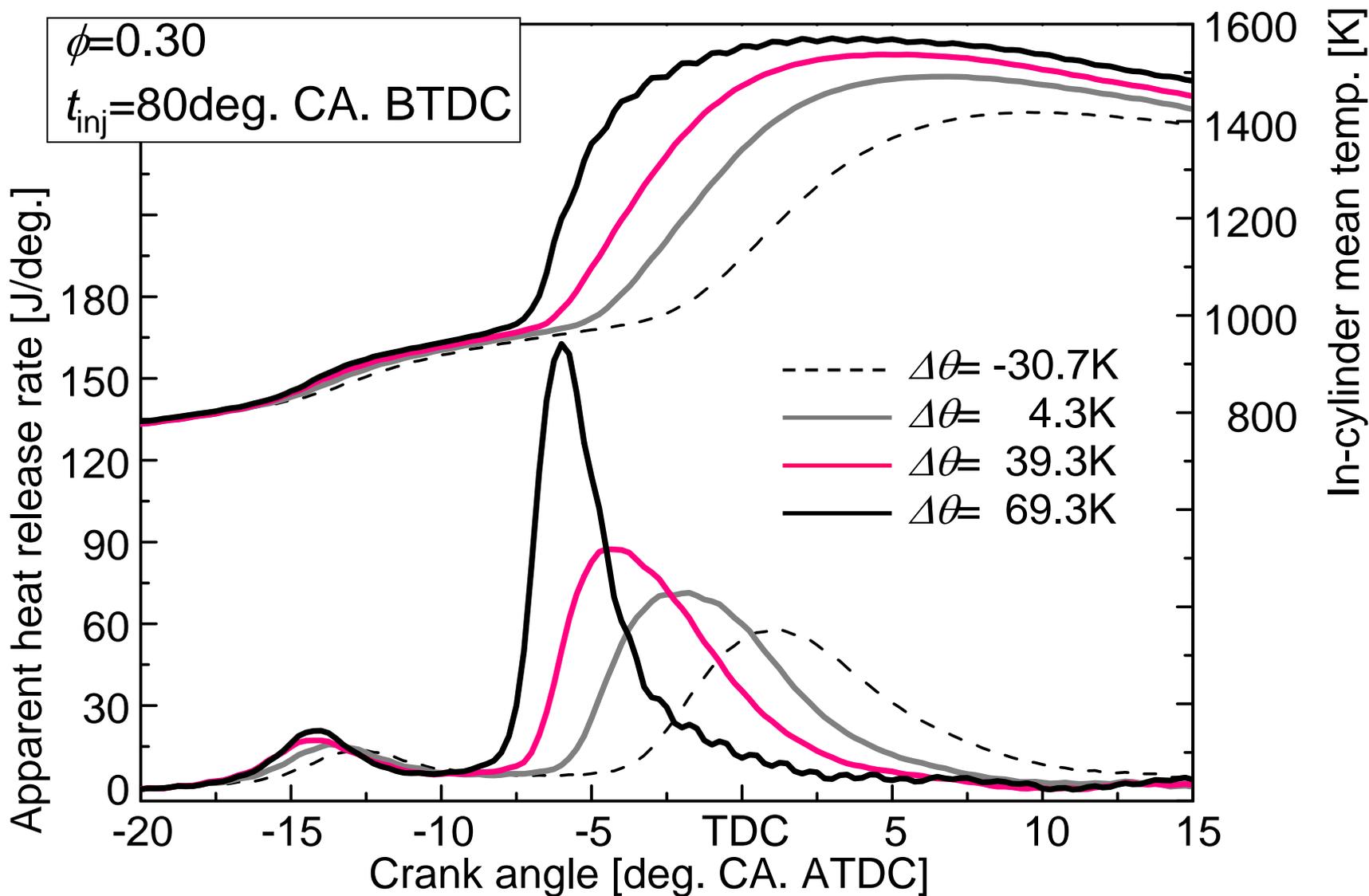




Specifications of Test Engine

Specification	Natural Aspirated, single cylinder, water cooled, 4 stroke cycle, 2 valves
Bore×Stroke [mm]	ϕ 110×106
Compression ratio [-]	13.0 : 1
Combustion chamber	Dish
Engine speed [rpm]	1200
Intake temp. [K] / humidity [%]	303 / 35
Water temp. [K] / Oil temp. [K]	353 / 342
Fuel injection system	Common-rail
Injection pressure [MPa]	50.0
Injection timing [deg. CA. BTDC]	100, 90, 80, 70, 60, 50, 40
Nozzle configuration	$dn=0.2\times 4$ (Spray Angle 60deg.)
Fuel	i-pentane/n-tridecane mixture (mole fraction of i-pentane =0.8)
Initial fuel temperature [K]	310, 345, 380, 410
Equivalent ratio [-]	0.20, 0.23, 0.27, 0.30

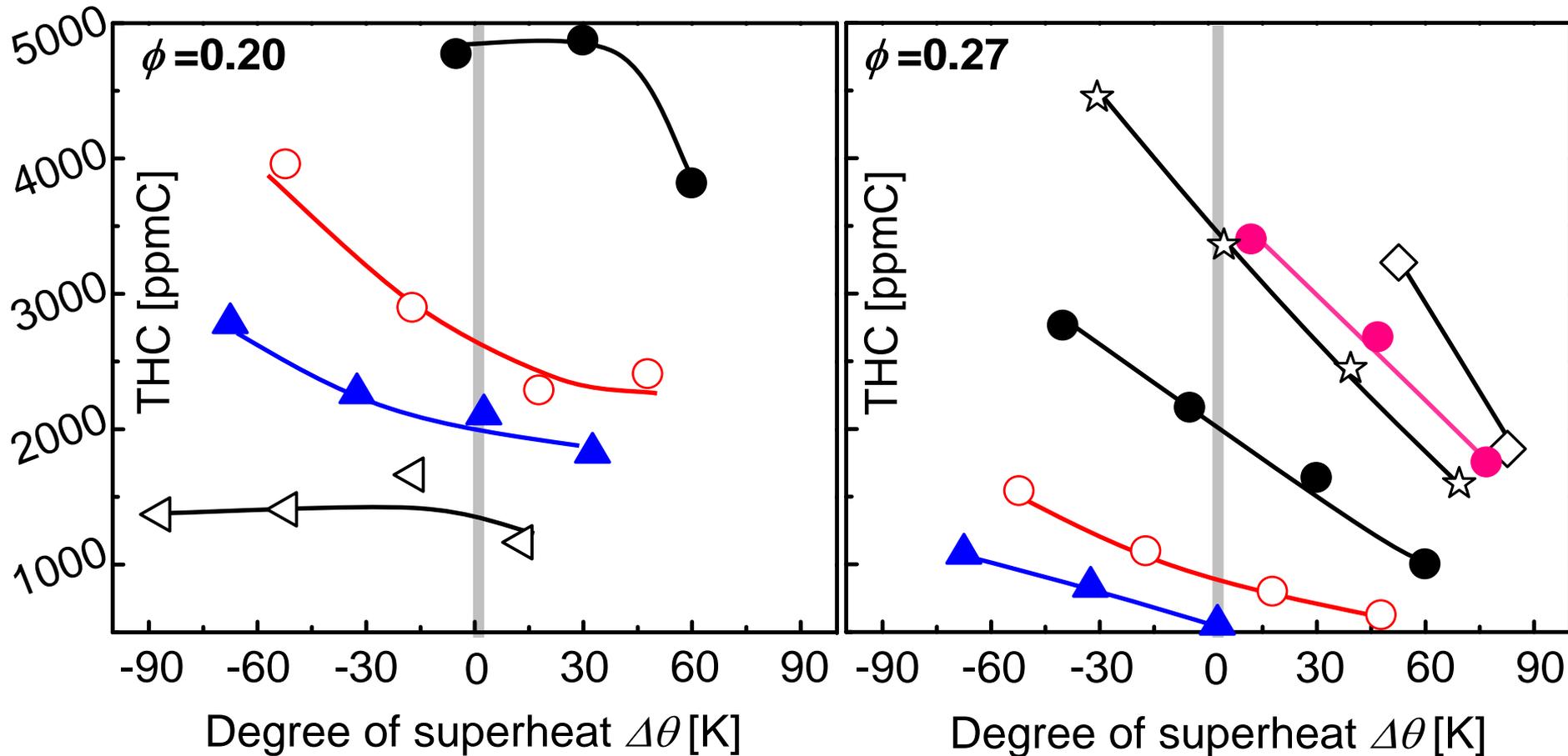
Histories of Apparent Heat Release Rate and In-Cylinder Mean Temperature



THC Emission as a Function of $\Delta\theta$

Start of injection

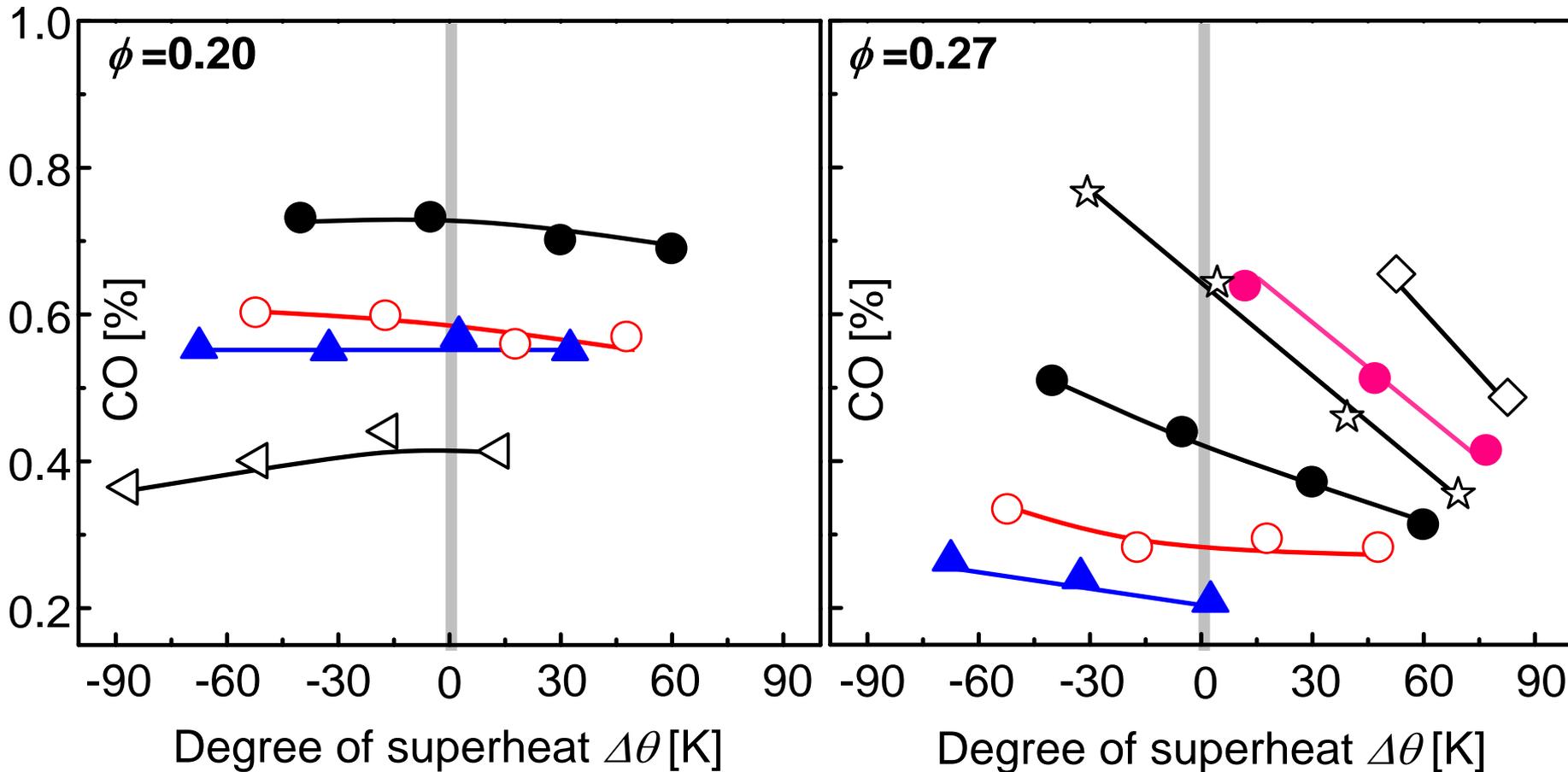
- | | | |
|-------------------|-------------------|--------------------|
| ◁ 40deg. CA. BTDC | ○ 60deg. CA. BTDC | ☆ 80deg. CA. BTDC |
| ▲ 50deg. CA. BTDC | ● 70deg. CA. BTDC | ● 90deg. CA. BTDC |
| | | ◇ 100deg. CA. BTDC |



CO Emission as a Function of $\Delta\theta$

Start of injection

- | | | |
|-------------------|-------------------|--------------------|
| ◁ 40deg. CA. BTDC | ○ 60deg. CA. BTDC | ☆ 80deg. CA. BTDC |
| ▲ 50deg. CA. BTDC | ● 70deg. CA. BTDC | ● 90deg. CA. BTDC |
| | | ◇ 100deg. CA. BTDC |





NO_x vs. Comb. Efficiency

