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Experimental study of the effect of NO and NO₂ on the oxidation of a mixture of primary reference fuels

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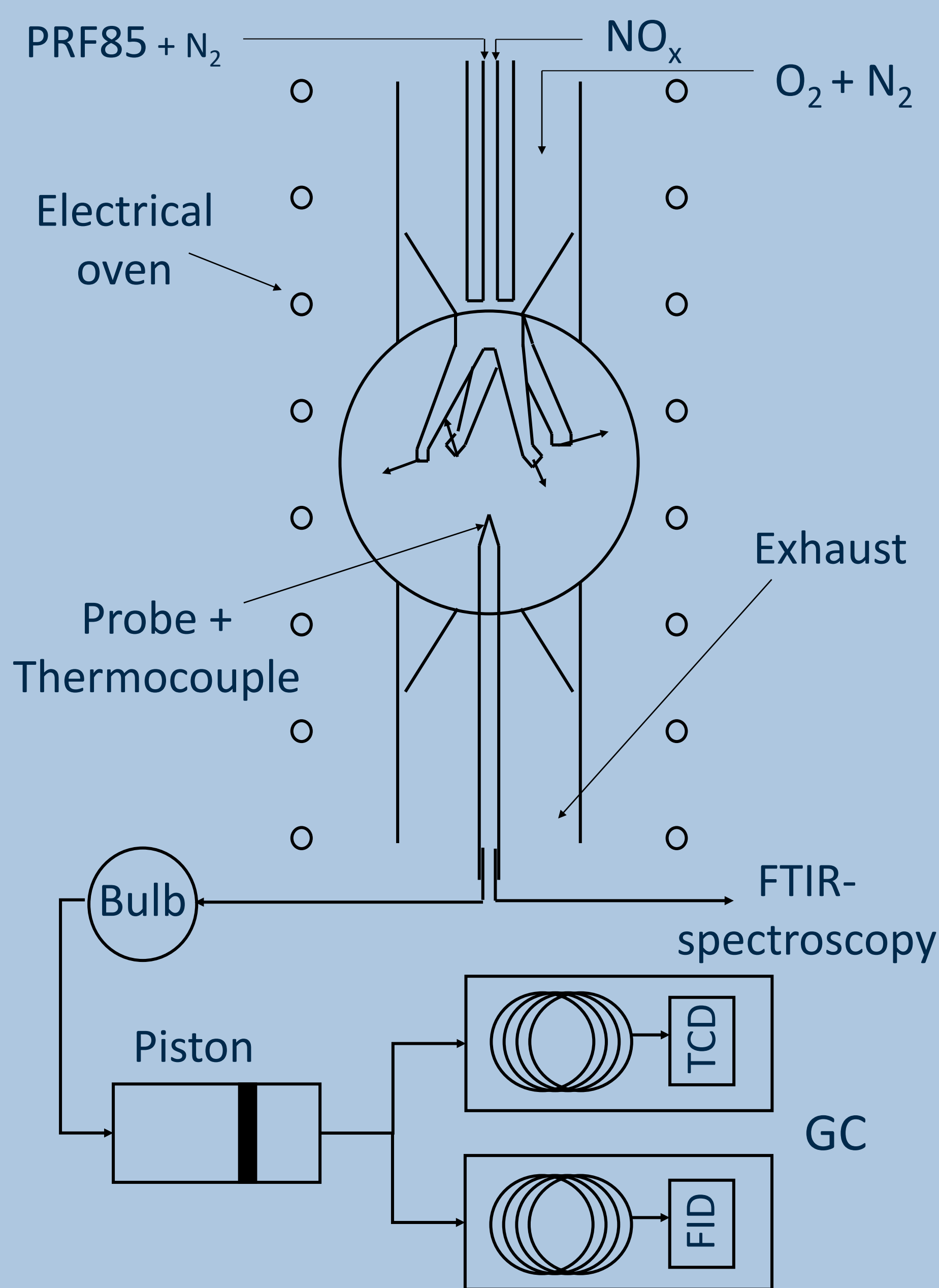
Traces of nitric oxides (NO or NO₂) are now well known to promote the ignition of simple fuels. This promoting effect is important in several practical systems among which:

- the NO-NO₂ conversion by hydrocarbons in recent NO_x-reduction strategies
- the modeling of combustion with exhaust-gas recirculation (EGR) in mild combustion

The complex interaction of nitric oxides and fuel mixtures is still poorly understood, especially at high level of NO_x.

New experimental results were obtained in Jet-Stirred Reactor (JSR) for the oxidation of a mixture of ca. 85% of iso-octane and 15% of n-heptane (PRF85) in presence (or not) of NO or NO₂ under **fuel-lean conditions** ($\phi = 0.2, 0.5, \text{ and } 0.7$), **high pressure** (10 atm) and over a **wide temperature range** (550-1000K). Concentration profiles of reactants, intermediates and final products were measured by GC and FTIR.

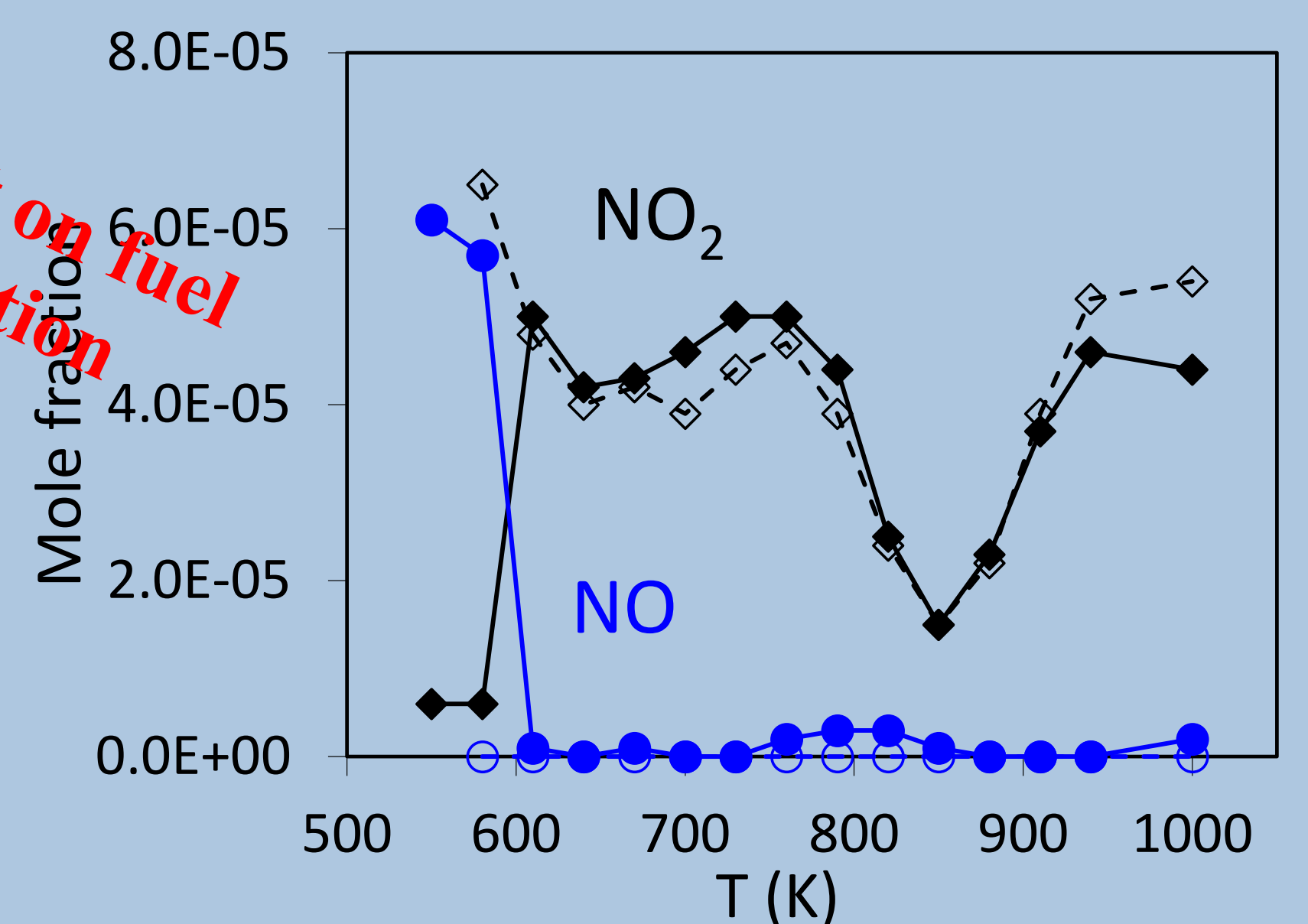
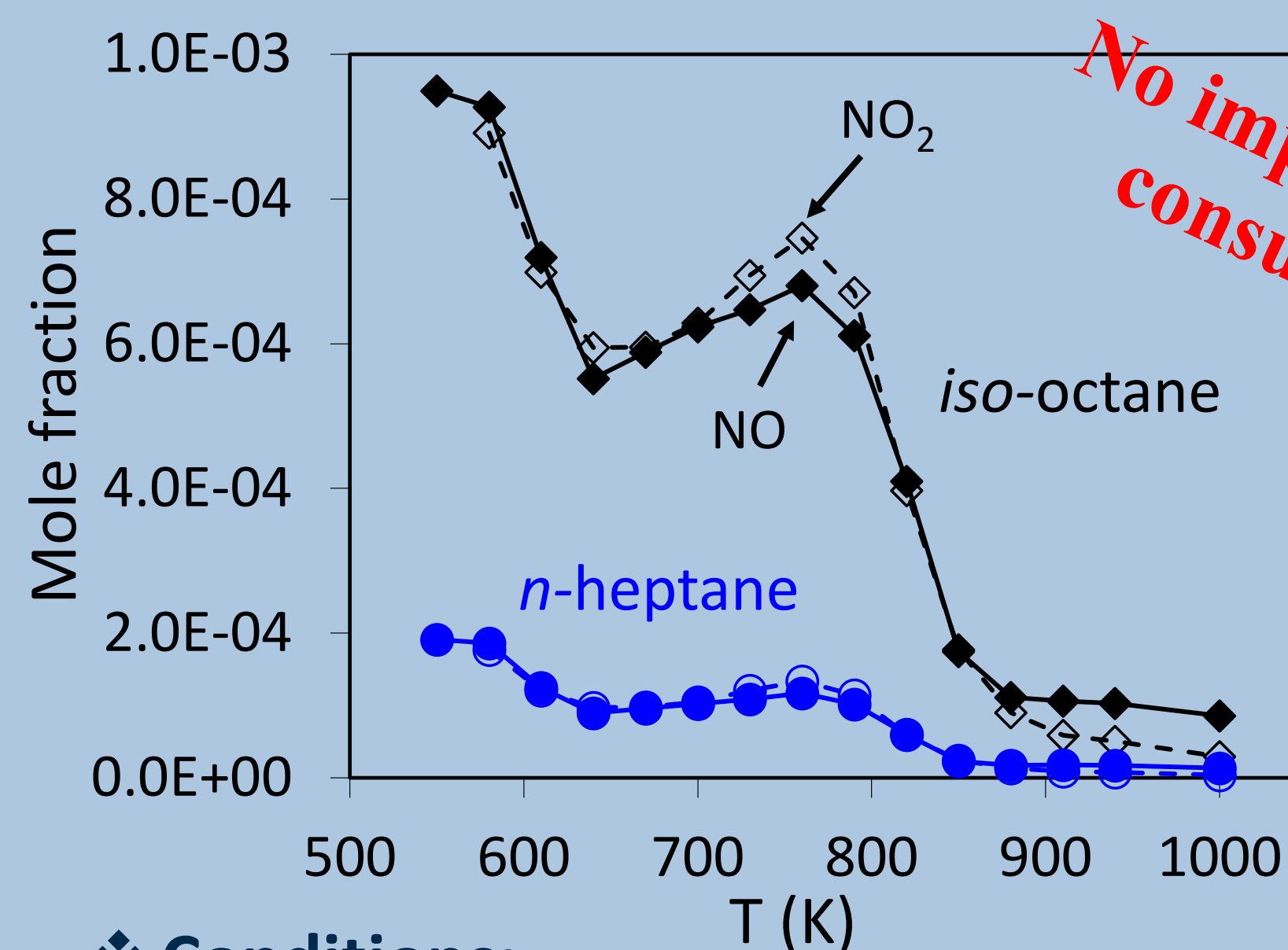
EXPERIMENTAL DEVICE



❖ Conditions:

$p = 10 \text{ atm} / \phi = 0.2 / \tau = 0.5 \text{ s}$

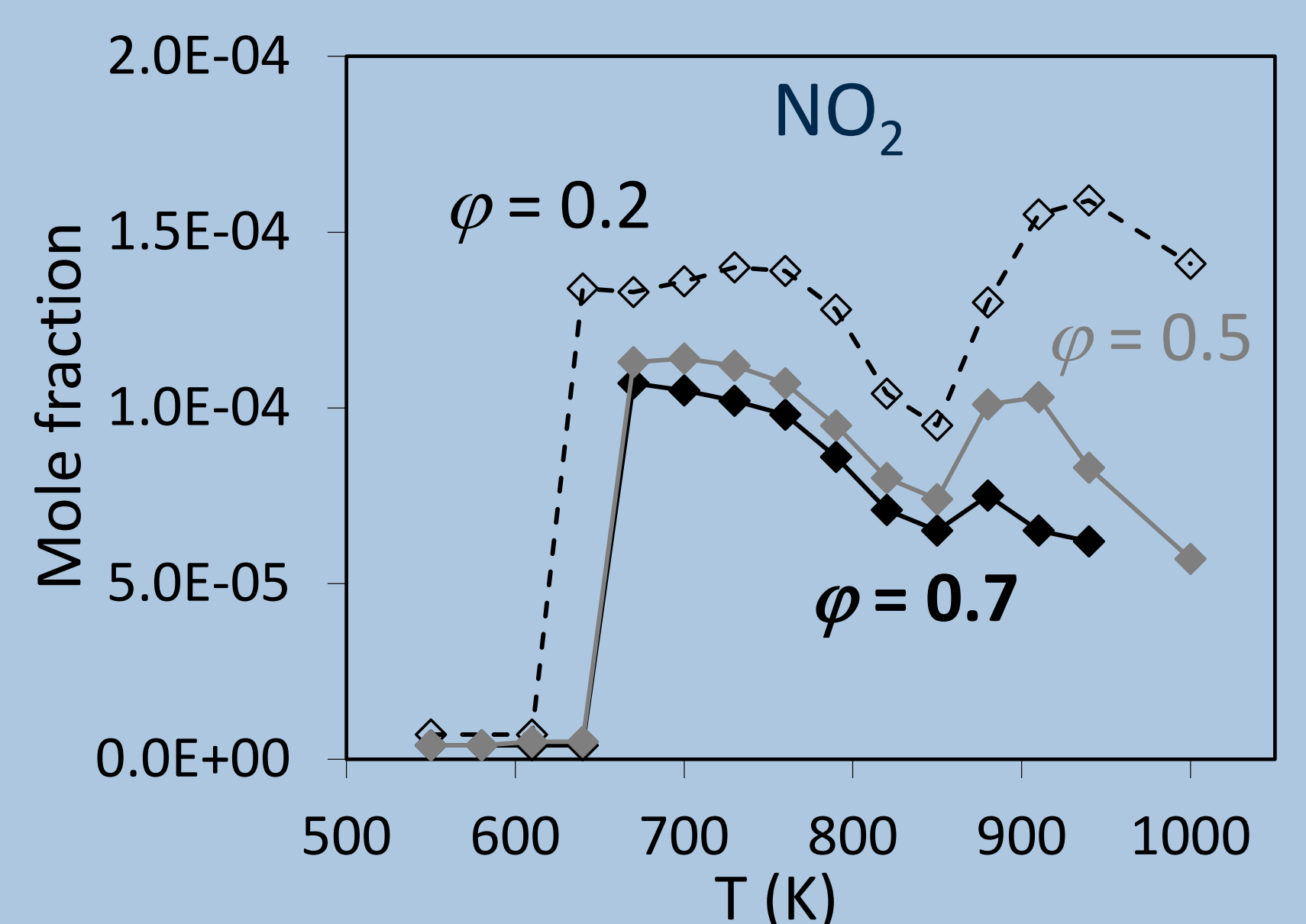
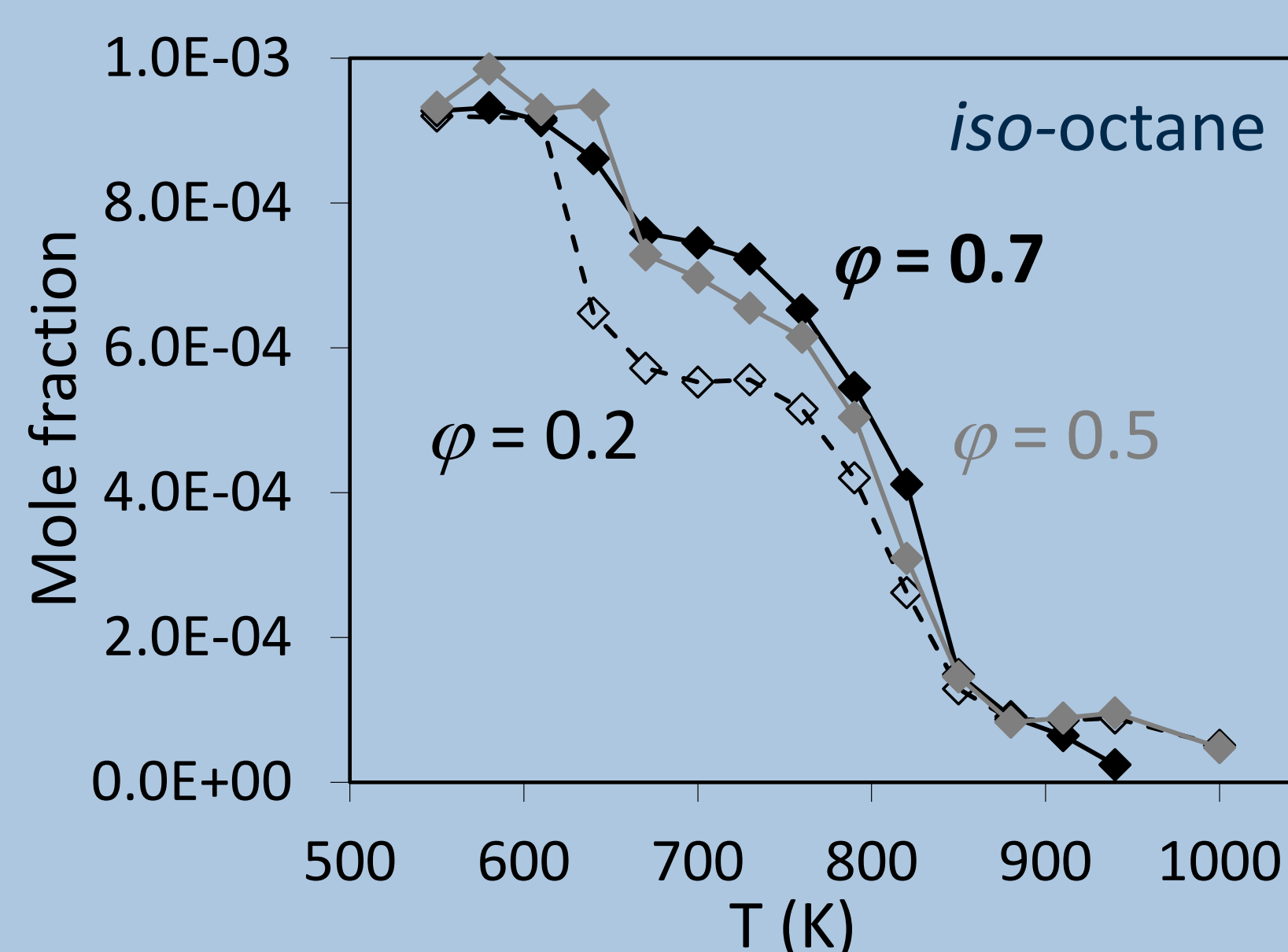
$X_{\text{ic8H18}} = 890 \text{ ppm} / X_{\text{nc7H16}} = 170 \text{ ppm} / X_{\text{NO}} \text{ or } X_{\text{NO}_2} = 60 \text{ ppm} / X_{\text{O}_2} = 6.1\%$



❖ Conditions:

$p = 10 \text{ atm} / \text{various } \phi / \tau = 0.5 \text{ s}$

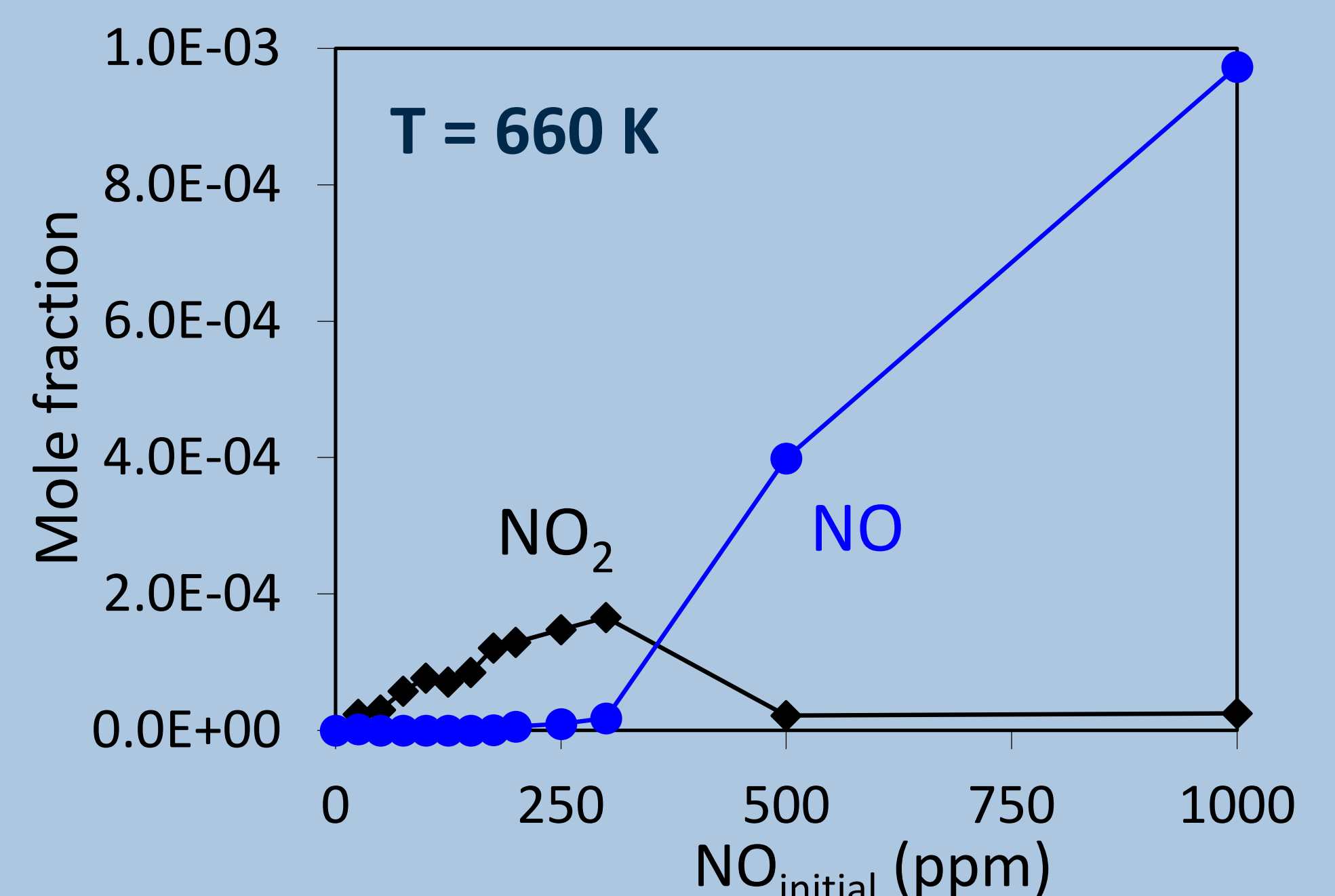
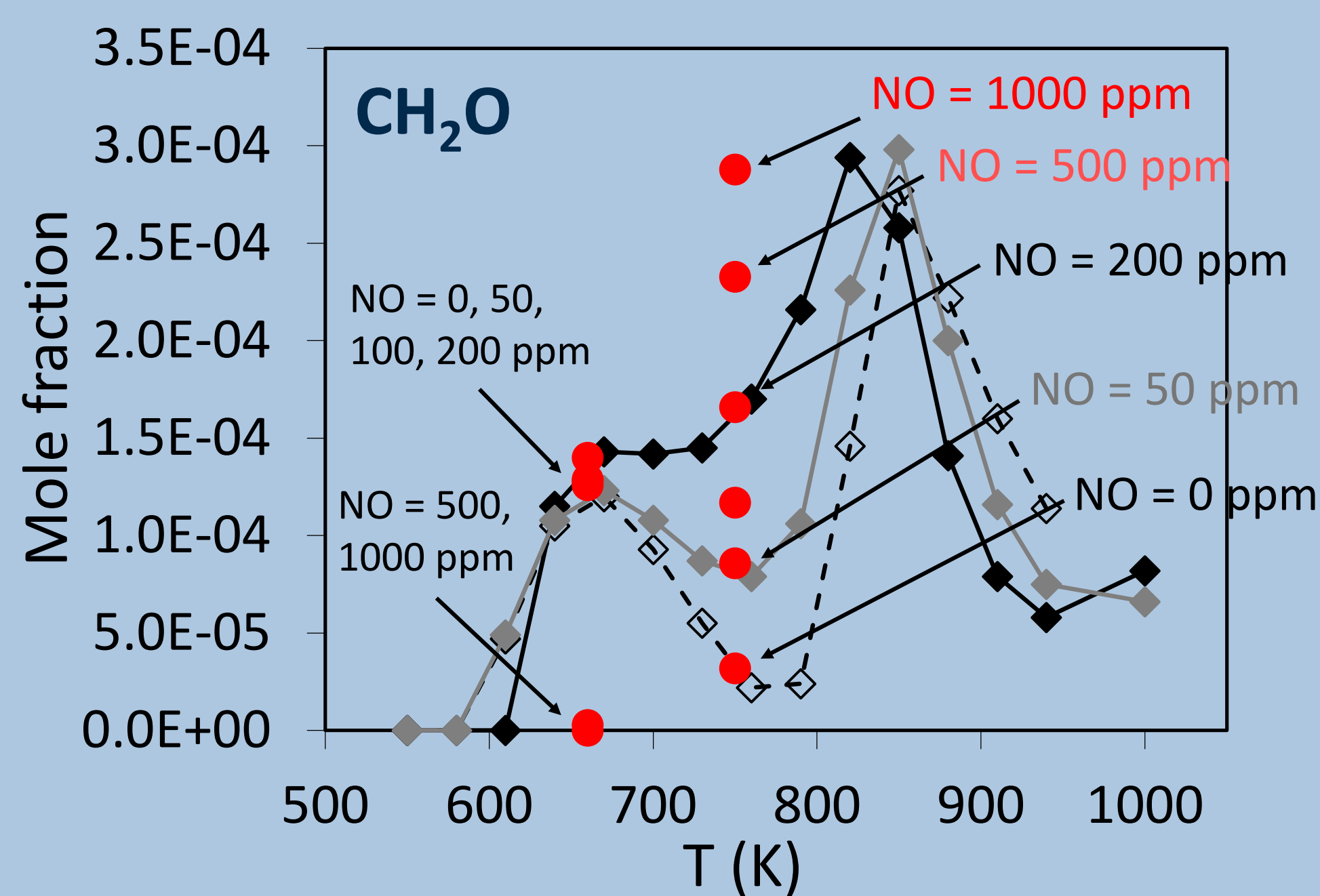
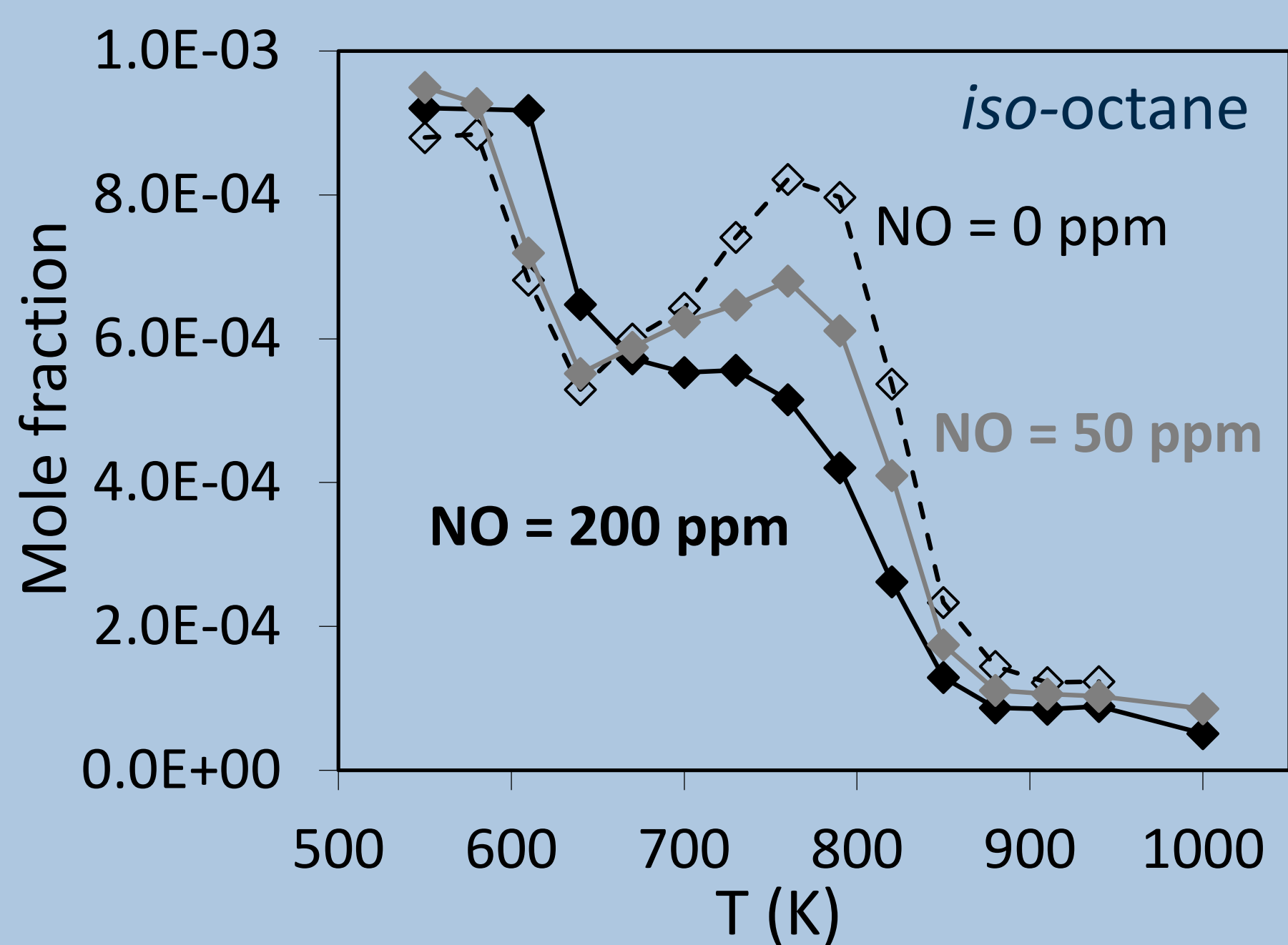
$X_{\text{ic8H18}} = 890 \text{ ppm} / X_{\text{nc7H16}} = 170 \text{ ppm} / X_{\text{NO}} = 200 \text{ ppm}$



❖ Conditions:

$p = 10 \text{ atm} / \phi = 0.2 / \tau = 0.5 \text{ s}$

$X_{\text{ic8H18}} = 890 \text{ ppm} / X_{\text{nc7H16}} = 170 \text{ ppm} / X_{\text{O}_2} = 6.1\% / \text{various } X_{\text{NO}}$



New data were obtained for the oxidation of a mixture of primary reference fuels (PRF85) in absence and **presence of NO or NO₂**. NO and NO₂ have very similar effects. When NO_x addition is increased, the Negative Temperature Coefficient (NTC) is erased. When NO_x addition is too high (> 200 ppm), the cool flame is erased. **The oxidation of NO by HO₂ promotes the conversion of the fuel** but, when the concentration of NO increases **the cool flame tends to disappear** due to the **formation of alkoxy radicals** via $\text{ROO} + \text{NO} \rightarrow \text{RO} + \text{NO}_2$ and possible **stabilization of HONO** ($\text{OH} + \text{NO} \rightarrow \text{HONO}$).