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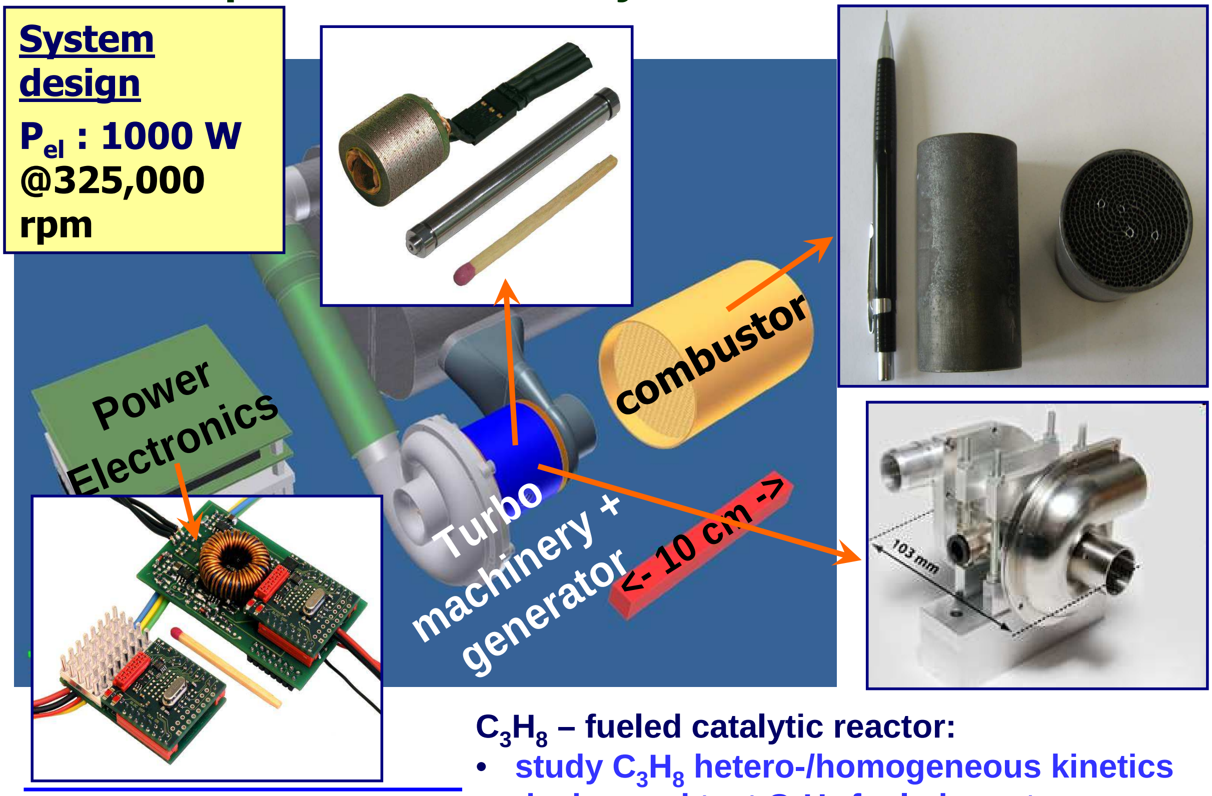
Propane-fueled catalytic microcombustor

System design

P_{el} : 1000 W @325,000 rpm

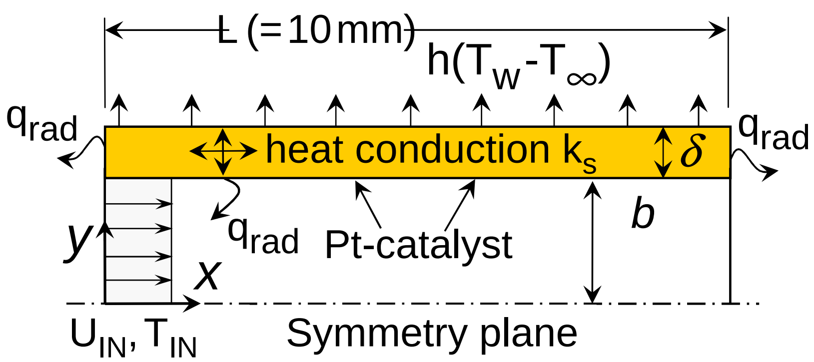


C_3H_8 – fueled catalytic reactor:

- **study C_3H_8 hetero-/homogeneous kinetics**
- **design and test C_3H_8-fueled reactor**

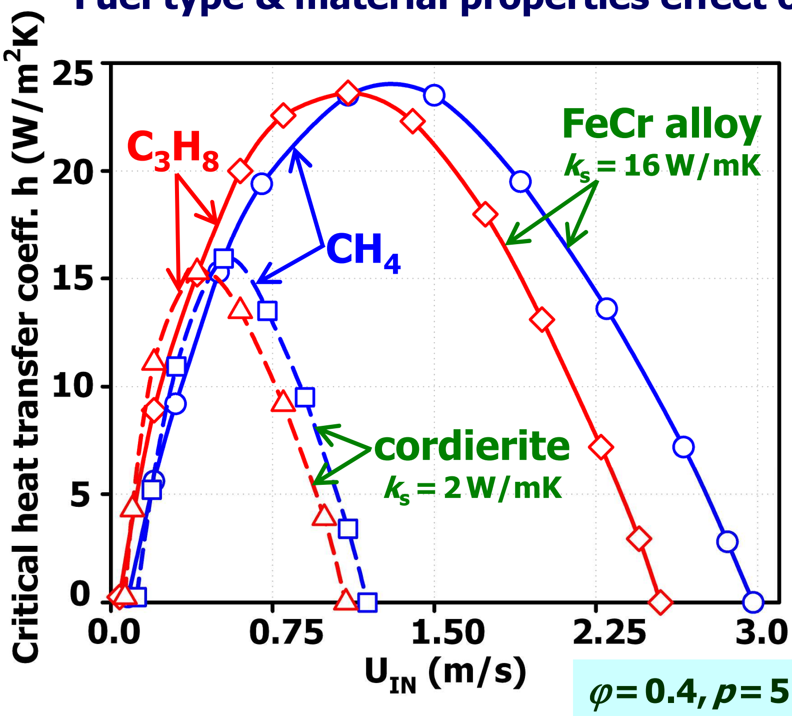
Stability maps in methane and propane-fueled catalytic microreactors (steady performance)

Geometrical configuration and modeled physicochemical processes



Catalytic Microreactors – Stability Maps

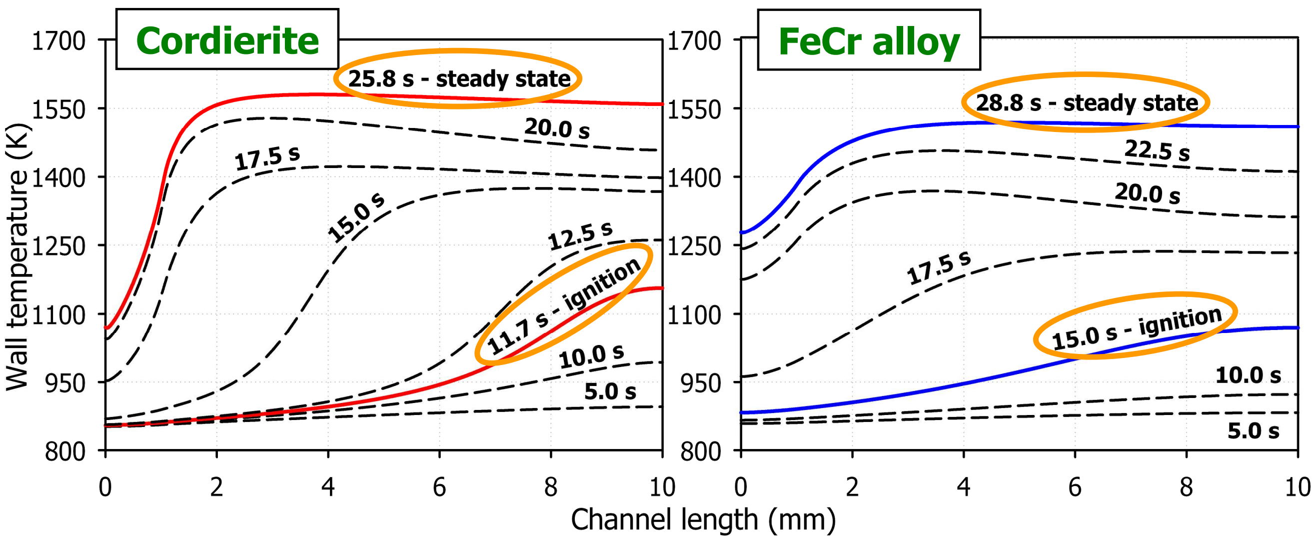
Fuel type & material properties effect on microreactor stability



- **Fuel transport affects microreactor stability**
- **Channel wall thermal conductivity k_s: highest impact on stability map**
- **Steady-state operation: metallic reactor favored**
- **FeCr alloy (high k_s): upstream heat transfer compensates efficiently for external heat losses at higher inlet velocities**

$\varphi = 0.4$, $p = 5$ bar, $T_{IN} = 700$ K, $b = 0.15$ mm

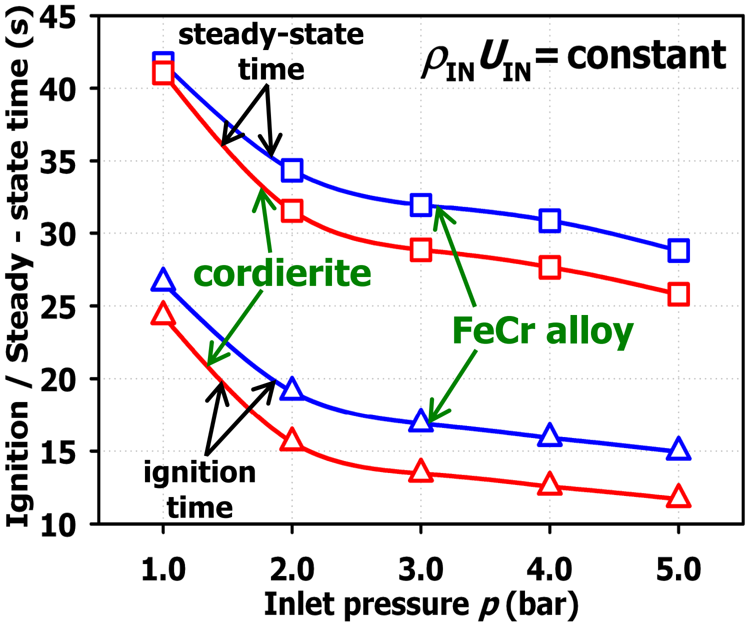
Catalytic Microreactor Start-Up (1)



- **Low wall thermal conductivity (ceramic material) reduces both ignition and steady-state times**
- **In contrast: high k_s materials preferable for steady-state operation**

$\varepsilon_{IN/OUT} = \varepsilon = 0.6$, $\varphi = 0.4$, $T_{IN} = 850$ K, $U_{IN} = 0.3$ m/s, $p = 5$ bar

Catalytic Microreactor Start-Up (2)



- **Five-fold increase in $p \Rightarrow$ two-fold decrease in time needed for ignition and steady-state**
- **Reaction front propagation speed: $\propto$ surface reaction rate $\Rightarrow p^{+0.47}$ dependence**
- **Ceramic materials (low k_s) display lower ignition and steady-state times for 1 bar $\leq p \leq$ 5 bar due to wall hot-spot formation**

$\varepsilon_{IN/OUT} = \varepsilon = 0.6$, $\varphi = 0.4$, $T_{IN} = 850$ K, $U_{IN} = 0.3$ m/s ($p = 5$ bar)