KAUST IFS Workshop

Plasma-chemical kinetics of NH_3 cracking

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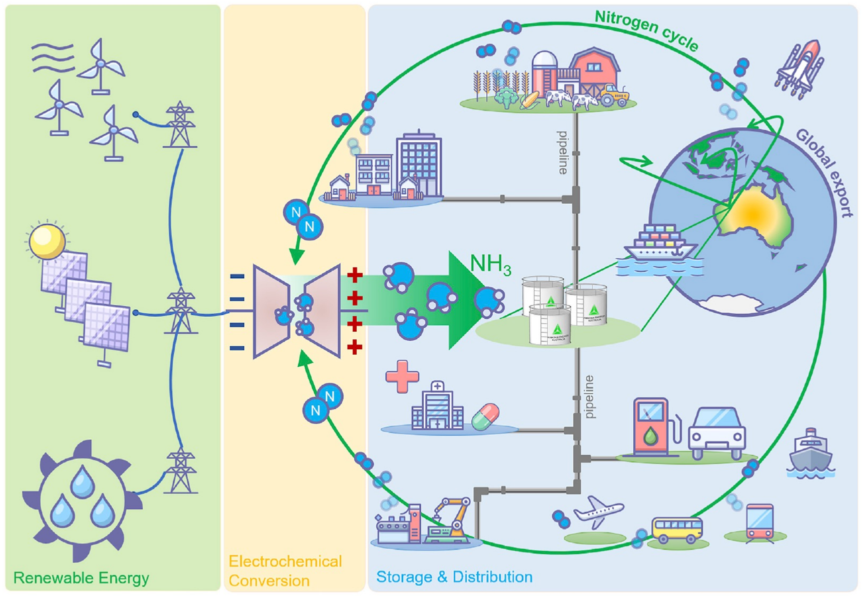
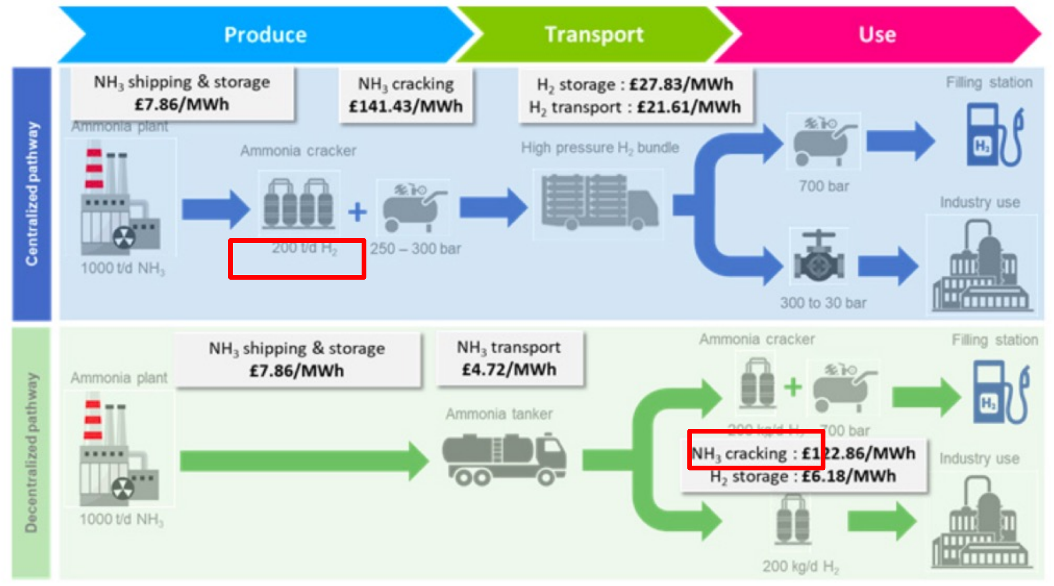
Introduction


(MacFarlane et al, 2020)

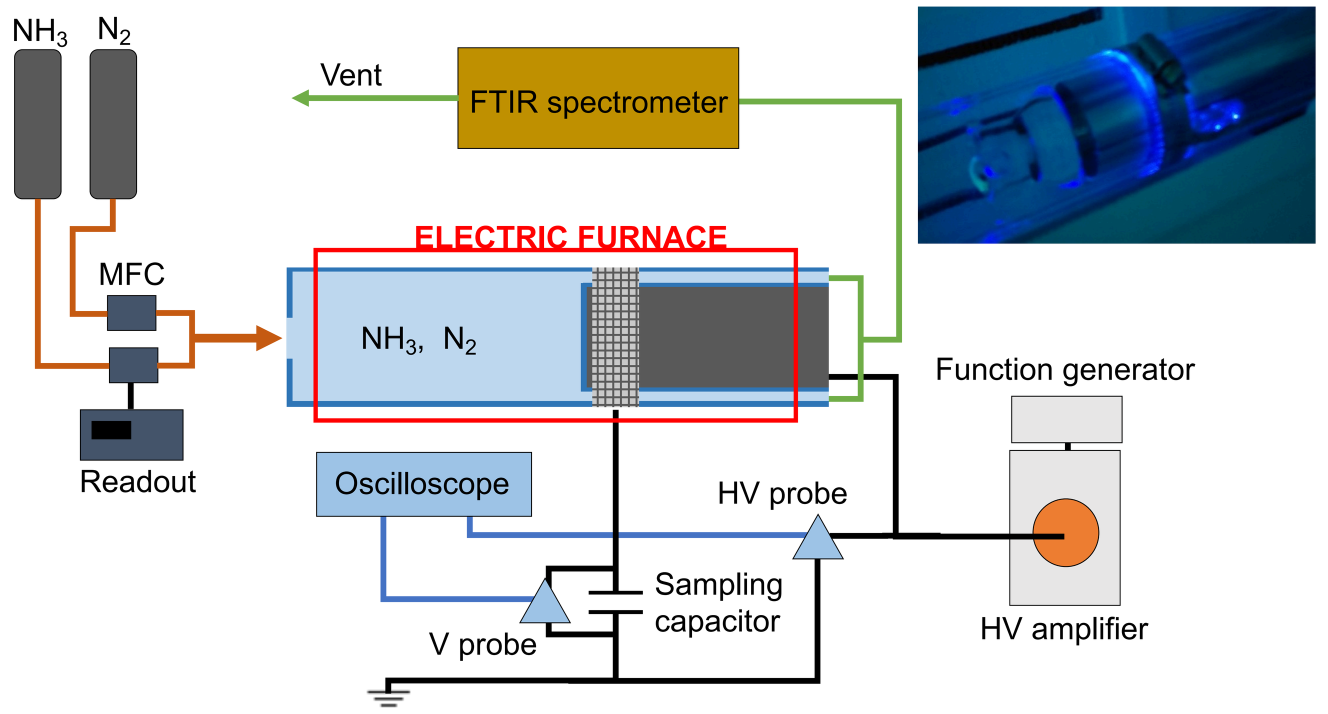


(UK Government, 2020)

- **NH_3 as an energy carrier**
  - H_2 production
  - Direct combustion
- **Limits of NH_3 cracking**
  - Conventional thermal cracking
    CO_2 emission, inflexible scale
  - Catalytic cracking
    Hard operation, expensive material

Methodology

Experiment



Initial concentration [mol%]		Discharge power (P_{dis}), [W]	Gas temperature (T_g), [K]
NH_3	N_2		
1.0	99.0	0	300–1300 (ΔT_g=100) 1300–1450 (ΔT_g=50)
		5 / 10 / 20	300–900 (ΔT_g=100)

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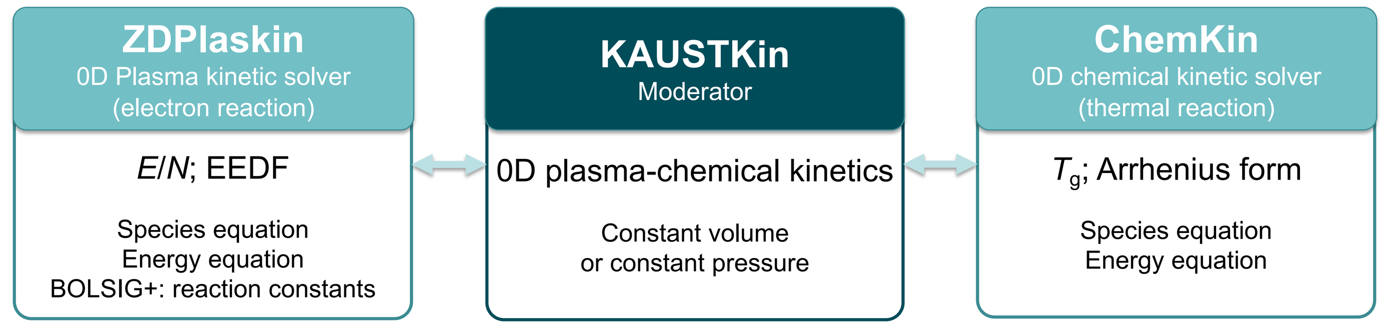
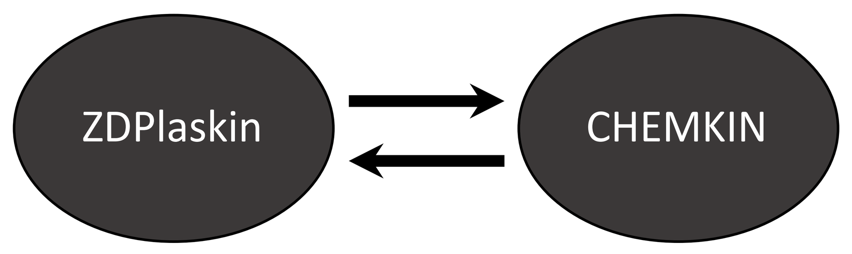
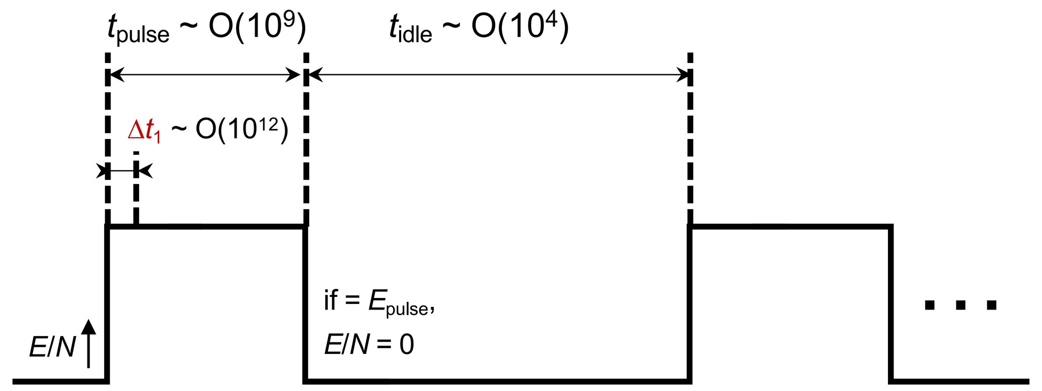


During Δt,



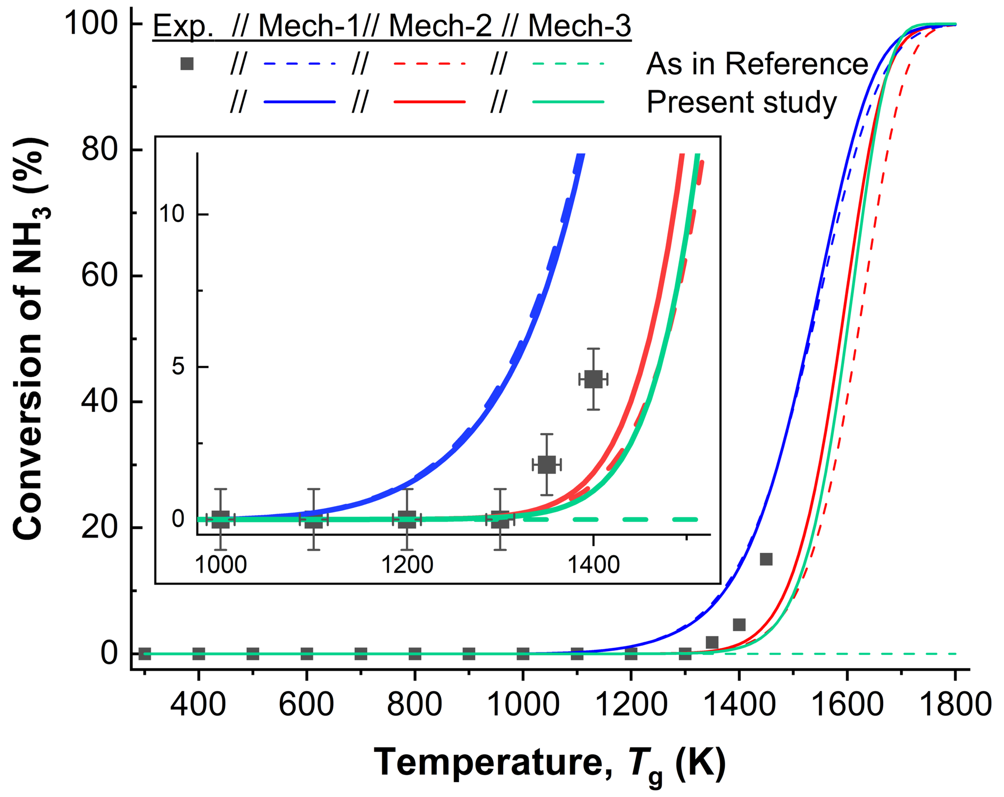


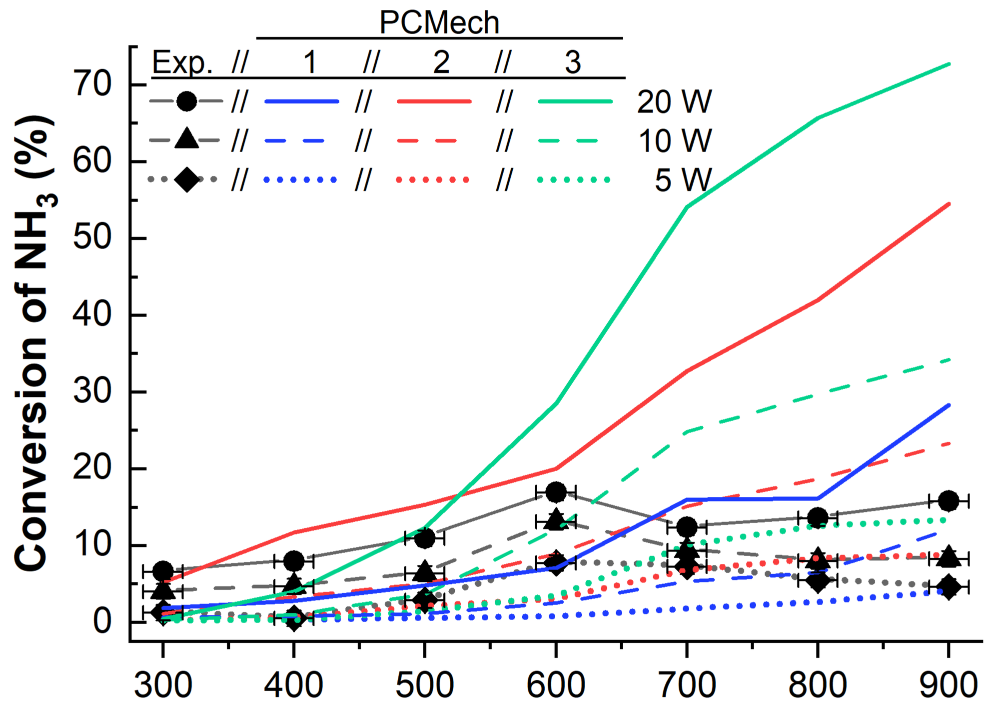
- Input
  P_0, T_0, $Y_{i,0}$, E/N, ED, t_{end}, n_{pulses}, E_{pulse}
- Output
  P_f, T_f, $Y_{i,f}$

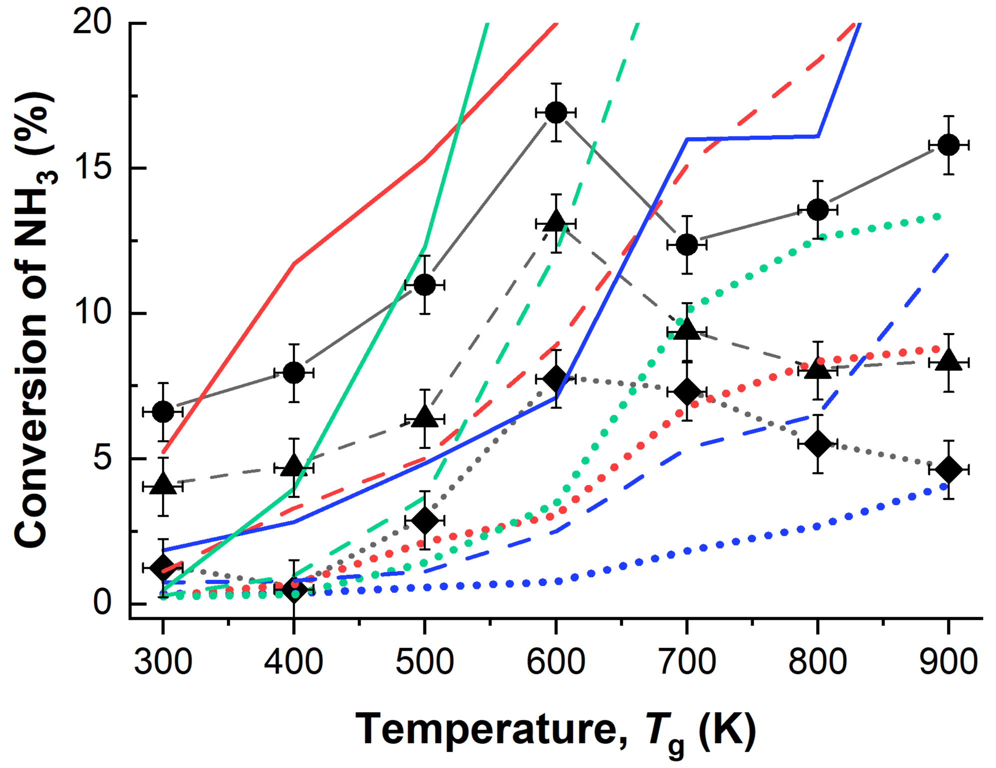
- **NH_3 Reaction mechanisms** (Thermal reactions + Plasma reactions)
  - *Mech-1(Zhang et al.) / Mech-2 (Alturaifi et al.) / Mech-3 (Van 't Veer et al.)*
  - *Van 't Veer et al. (Electron impact, excited species, ion chemistry)*

Results

Conversion of 1-mol% NH_3







Reaction sensitivity analysis