UT Energy Week
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Crum Auditorium
UT Austin

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The University of Texas at Austin

Ammonia Reforming to Hydrogen using Non-Equilibrium Plasma Discharges

Ammonia valorization by complete or partial reforming to hydrogen in distributed plasma activated reactors

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Efficient reforming of NH_3 to H_2 via plasma

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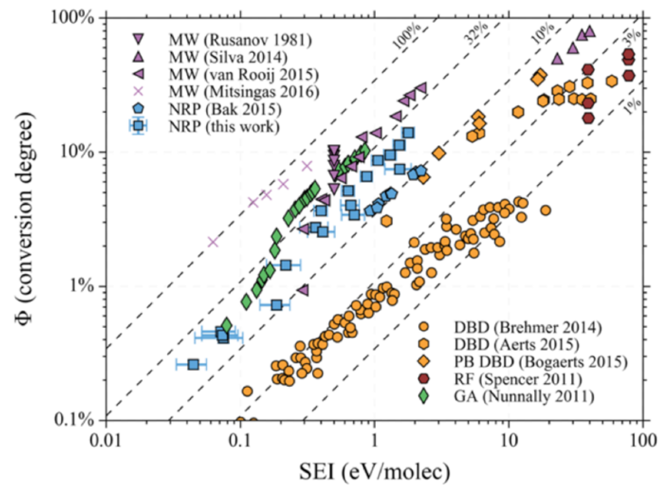
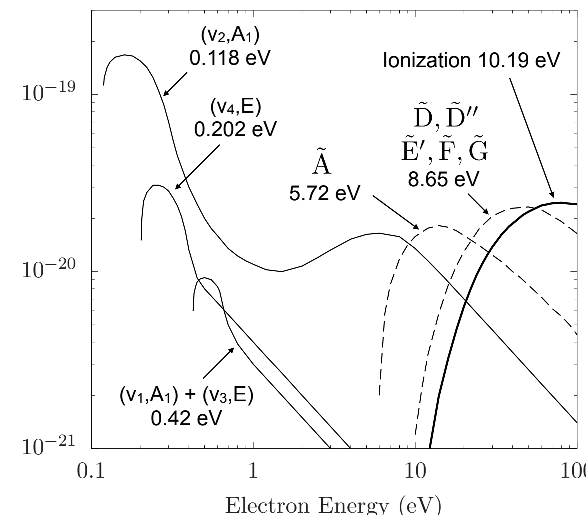
- NH_3 has enormous potential as (a) hydrogen storage and vector, and (b) carbon-free fuel for power generation.

- Complete or partial reforming of ammonia to hydrogen via $2\,\mathrm{NH_3} \longrightarrow 3\,\mathrm{H_2} + \mathrm{N_2}\,(\Delta H_0^f = 0.47\ \mathrm{eV/molec\ at\ 25\ °C})$ is commonly catalyzed by transition metals (Ru, Ni, Fe, and Ir) at 600 °C and elevated pressures.

- **Novel concept:** Energize the internal states of NH_3 (vibrational and electronic) by electron impact in non-equilibrium plasmas and promote bond breaking at lower temperatures (200 °C)

- **Objectives:** (1) Characterize experimentally yield and energy efficiency; (2) Validate a computational model for vibrational excitation of ammonia





Experiments demonstrate H_2 production with RF excitation & low-energy electrons

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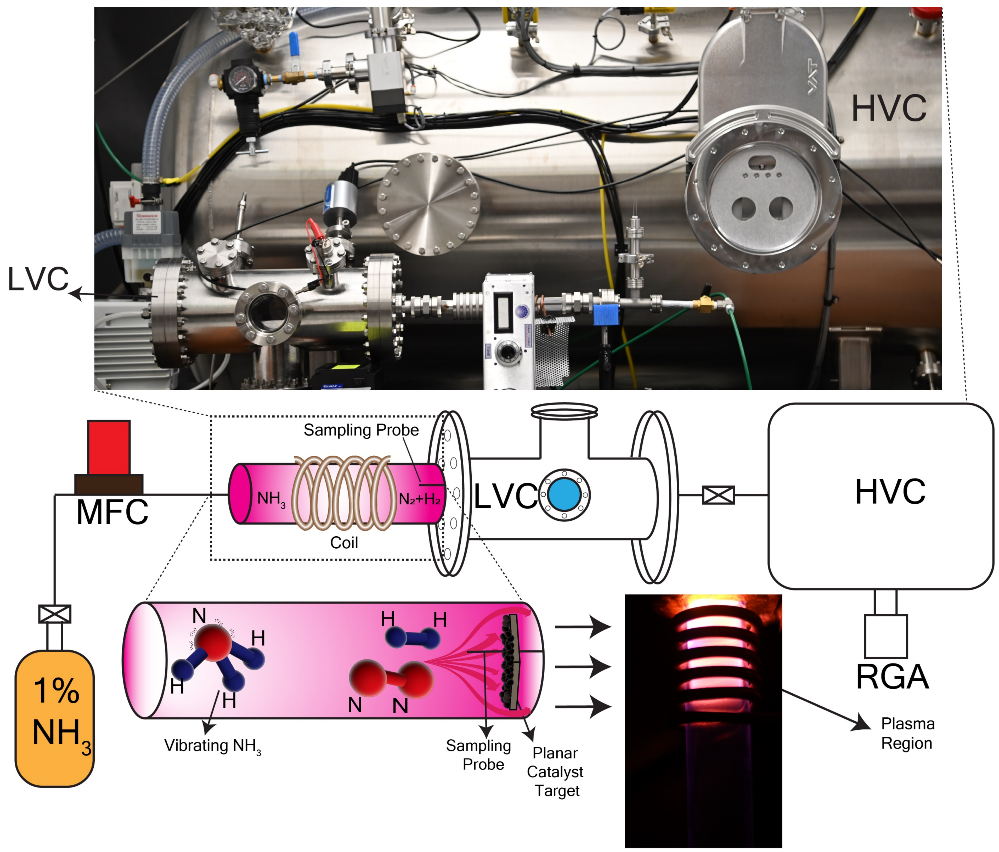

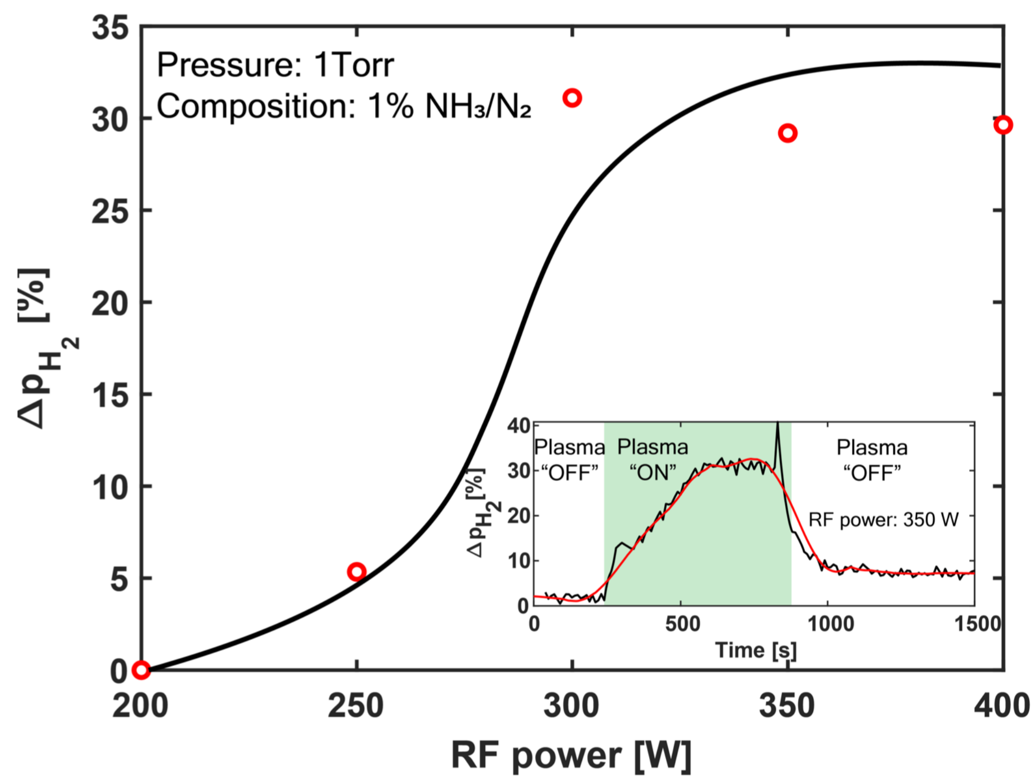

Preliminary modeling shows effect of vibrationally “hot” ammonia on volcano plots

Elementary reactions

$$NH_3^{(v)}(g) + 2^* \rightleftarrows NH_2^* + H^*$$

$$NH_2^* + * \rightleftarrows NH^* + H^*$$

$$NH^* + * \rightleftarrows N^* + H^*$$

$$H^* + H^* \rightleftarrows H_2(g) + 2*$$

$$N^* + N^* \rightleftarrows N_2(g) + 2*$$