Cavity Ring-Down Spectroscopy to Analyze Gas Composition on the Catalytic Sample Surface

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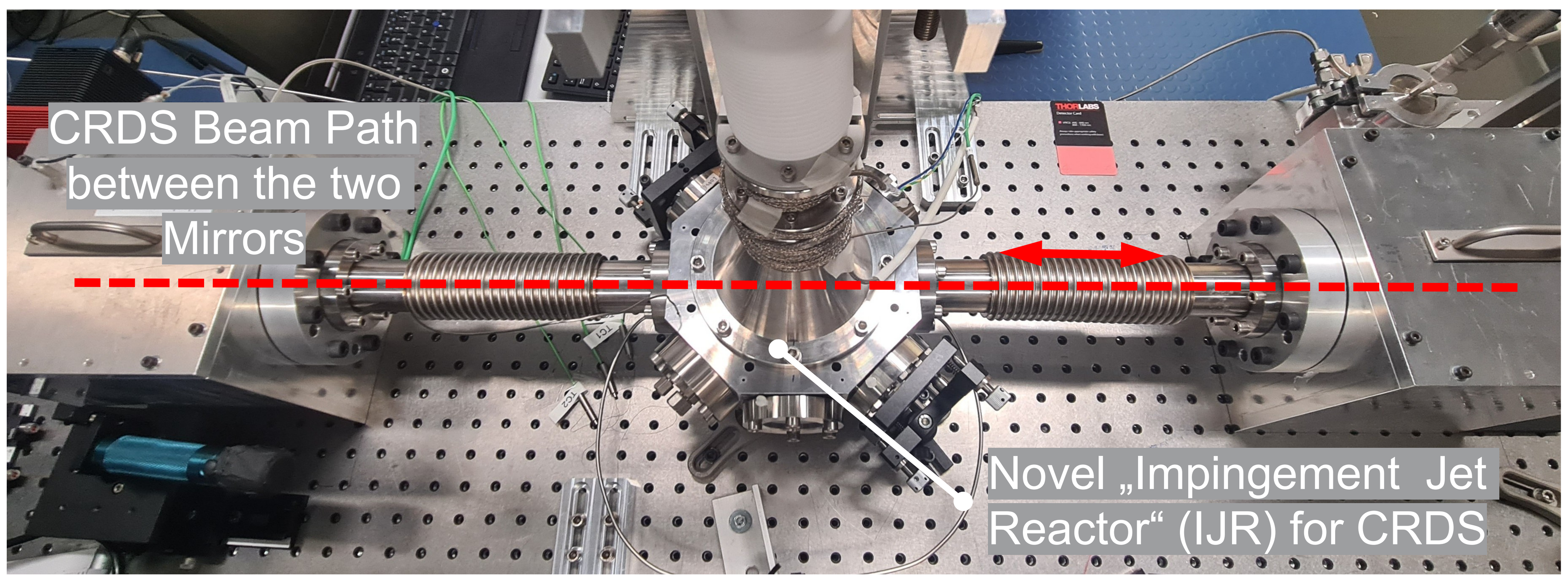
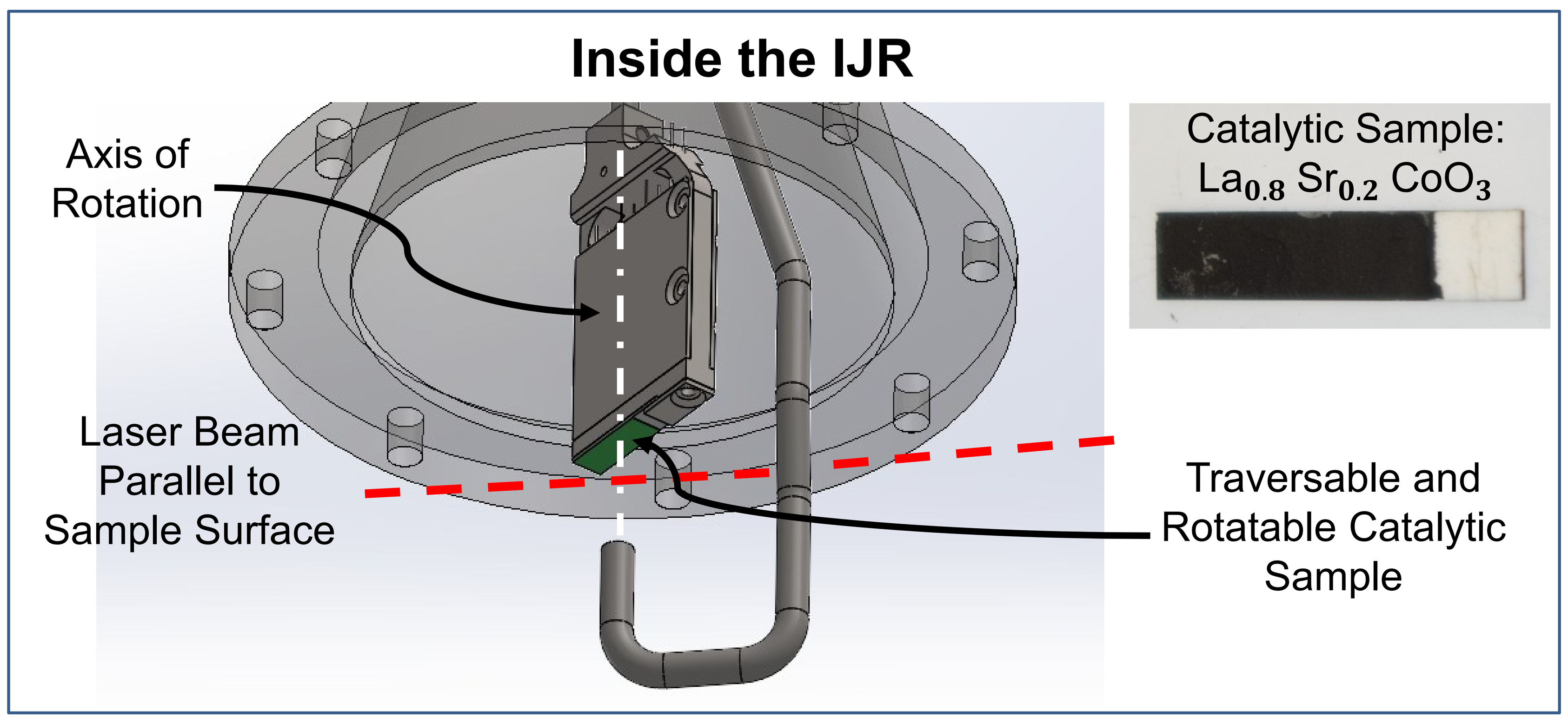
1. Motivation

Enhancing catalytic process efficiency necessitates a deeper insight into the fundamental reaction mechanisms. Achieving this requires knowledge of the species concentration as a function of time and space, which is influenced by the catalytic substrate used. Determining this species concentration requires advanced in-situ spectroscopic techniques capable of high-resolution and highly sensitive gas-phase characterization.



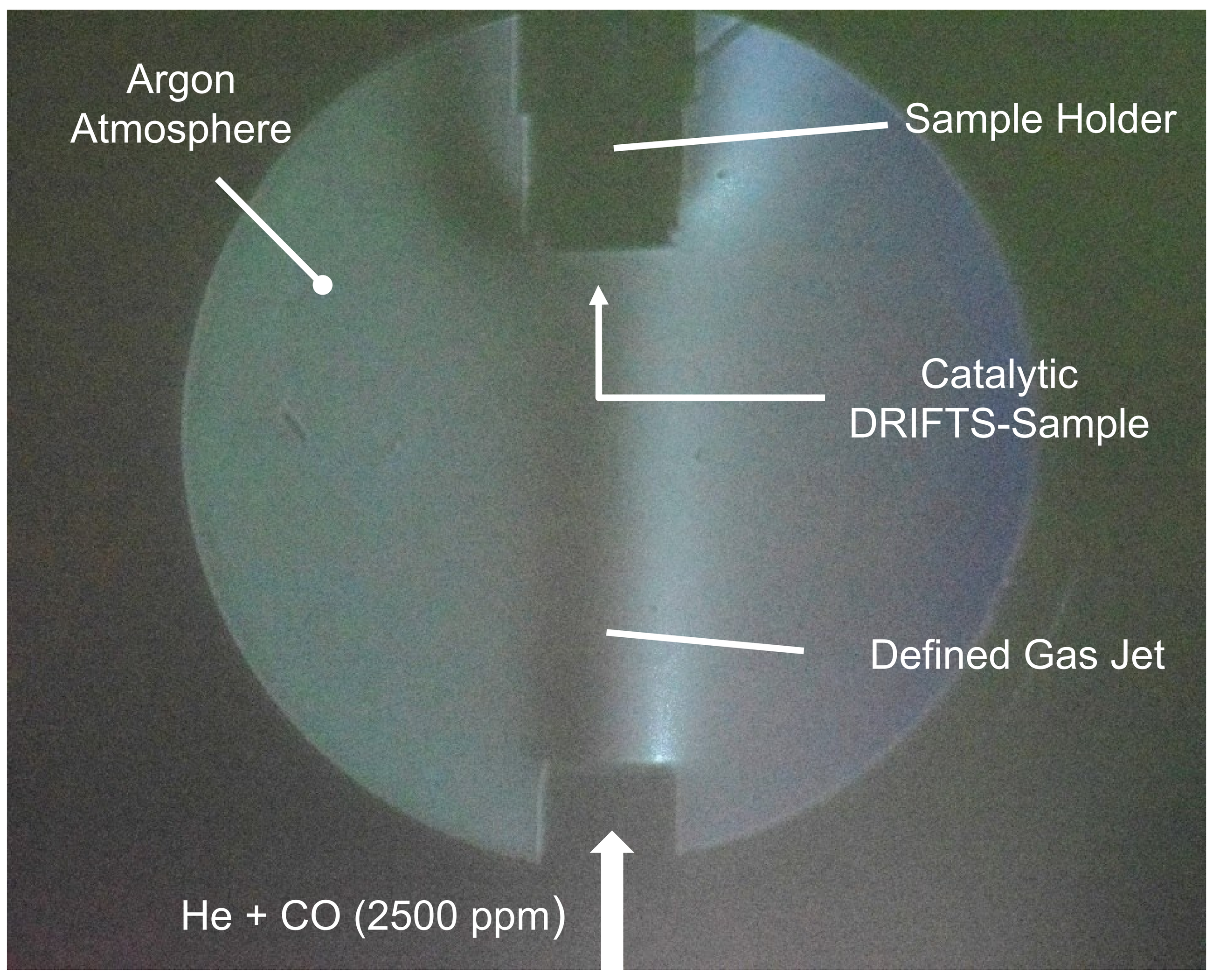
2. Method

To address this, WSA has developed a cavity ring-down spectrometer (CRDS) [1], enabling both temporal and spatial resolution of multiple species above a catalytic surface. CRDS is widely recognized for its exceptional sensitivity, allowing the detection of species at very low concentrations ($< 1 \times 10^{12}$ molecules/cm³).



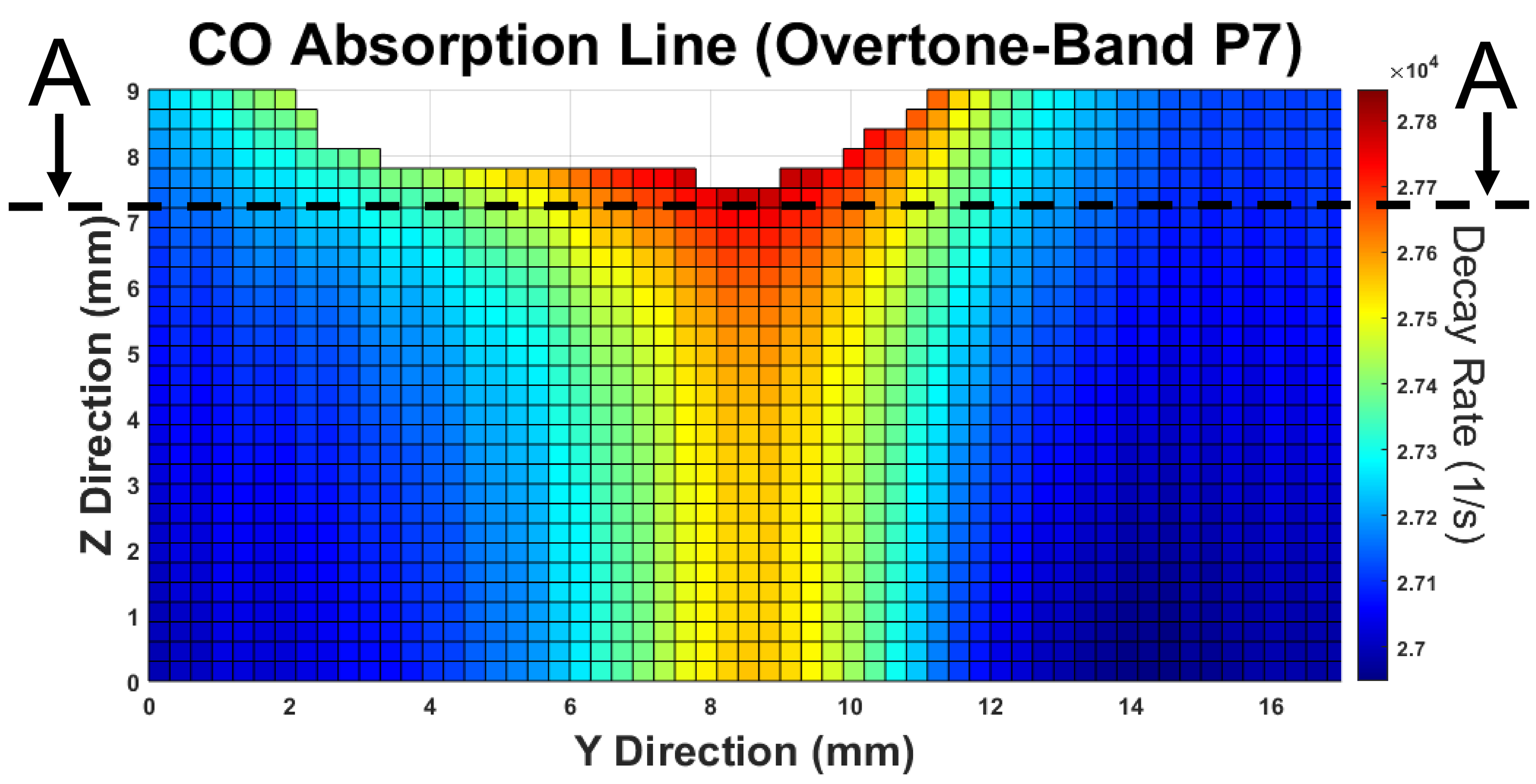
3. Schlieren Monitoring

- Visual overview of flow field
  - Identifying flow pattern (e.g. jet misalignment)
  - Checking flow field appearance for different flow rates

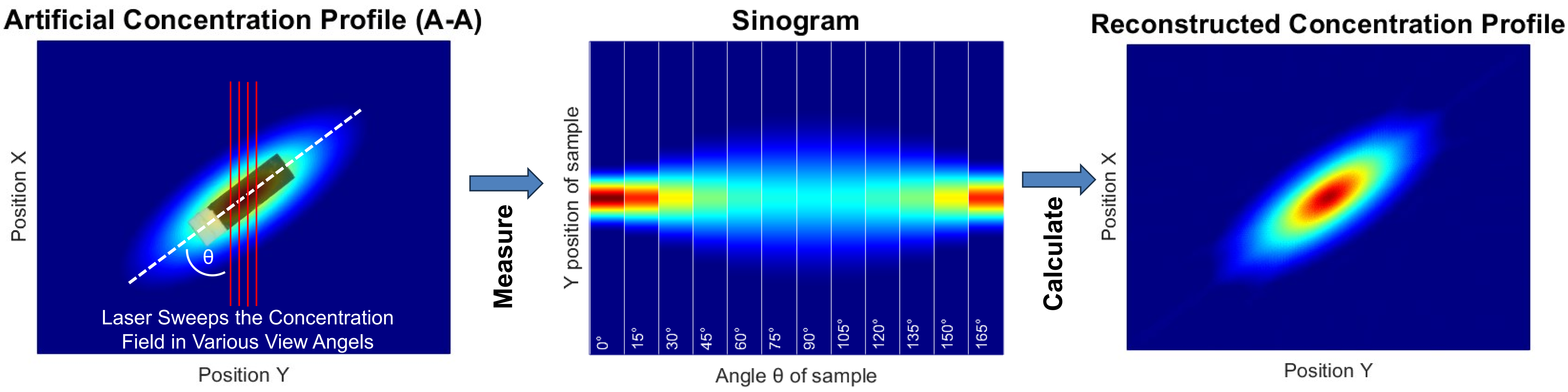


4. CRDS Results

- Each pixel is the mean value of around 30 CRDS measurements (number of pixel is 1710)
- 5 hours of measurement for the whole image
- Size of the pixels is 0.3 mm (almost the same as the diameter of the laser beam)



5. Outlook: Tomography



References

[1] Luís Felipe F. M. Barbosa, Philip B. Dubowik, Manuel A. Reddemann, Reinhold Kneer; Development of a cavity ring-down spectrometer toward multi-species composition. Rev. Sci. Instrum. 1 October 2023; 94 (10): 105117. https://doi.org/10.1063/5.0149765