

Deepak Pradeep (ESR 04)

started: October 15, 2021

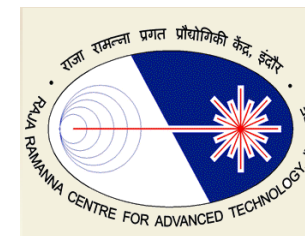
Education:

(Integrated) MSc in Photonics

Cochin, India

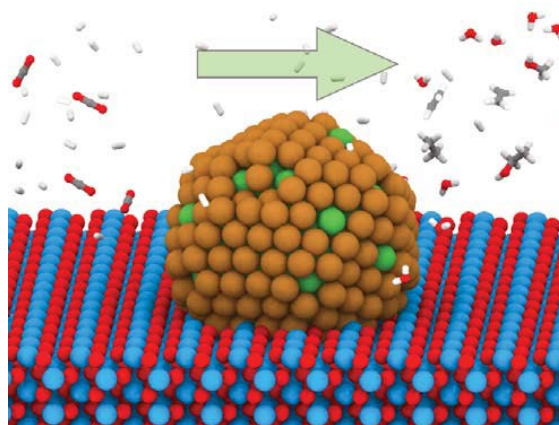


- Internship: e⁻ attachment mediated dissociation (EAD) of O₂ molecules (detection: Velocity Map Imaging)
- MSc thesis: crystal growth of Nd/Cr: YVO₄ for laser self Q-switching



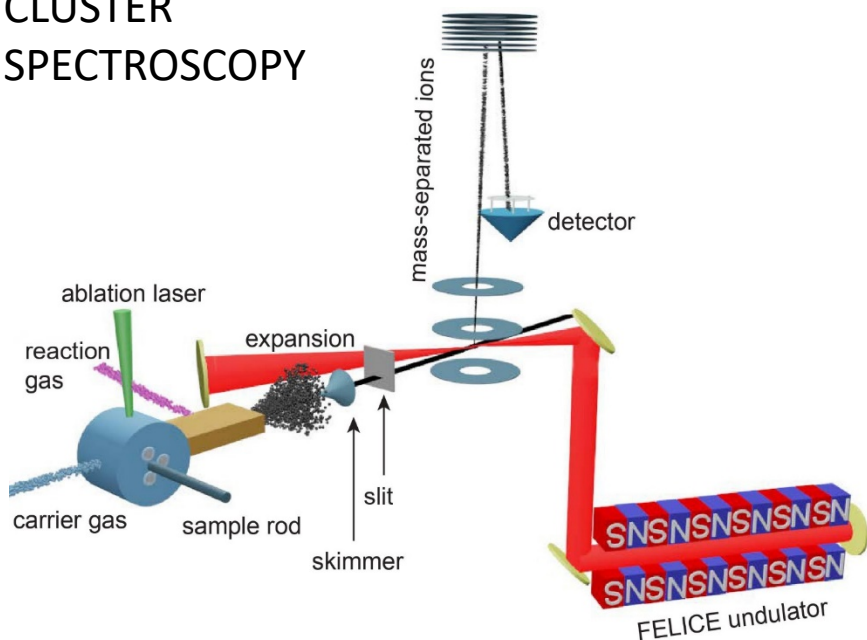
Catchy Project

Understanding bifunctional reaction mechanisms in CO₂ hydrogenation on free clusters.



WP4: Free cluster reactivity

- Study the interaction between isolated bimetallic clusters, CO₂, and H₂ in the gas phase.

CLUSTER
SPECTROSCOPY

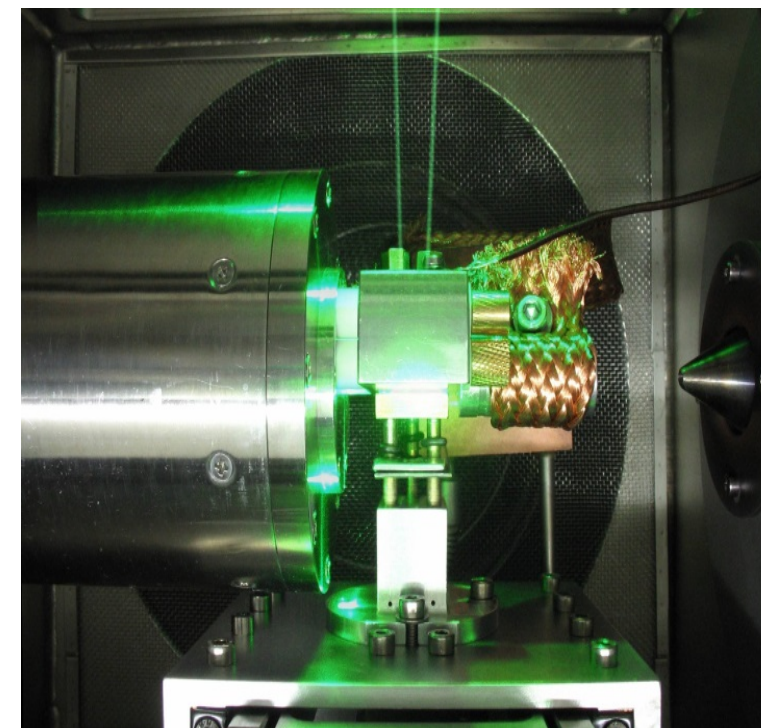
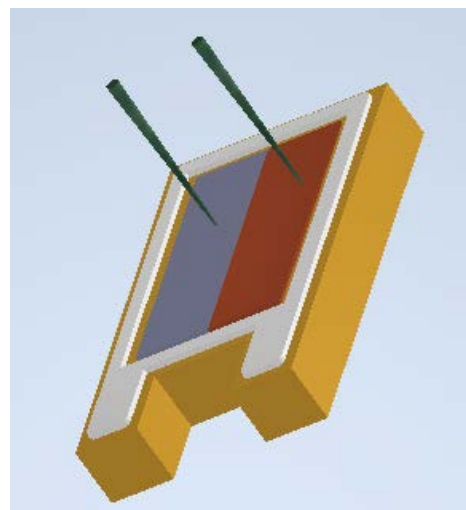
- Produce clusters by laser ablation
- React clusters with CO₂ and/or H₂
- IR spectroscopic characterization
- Mass spectrometric detection
- IR spectra complemented by DFT calculations.

NEW SOURCE: A DUAL-LASER ABLATION SOURCE

Present source: laser ablation of a pure metal rod

New source: two planar targets:

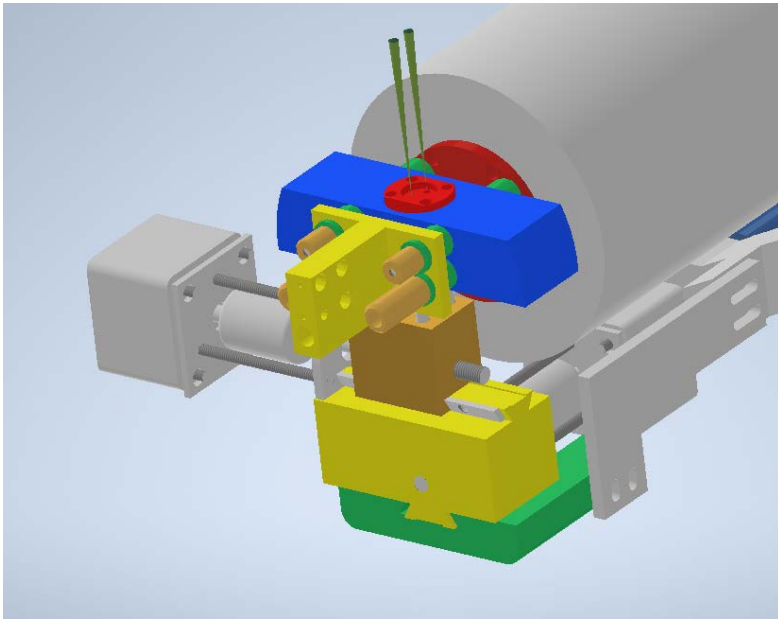
- Lower material consumption
- Flexibility in elemental composition



Bimetallic cluster source at KU Leuven

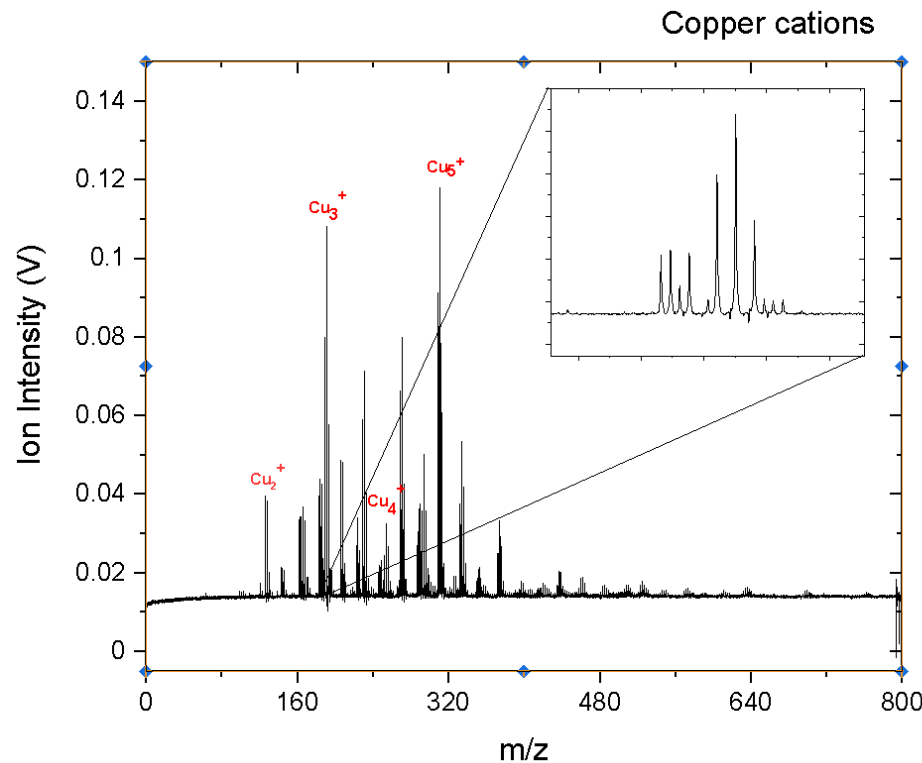
MY PROGRESS

INVENTOR: adapt KUL source design for
RU instruments



- Introduce some new parts
- Adapt parts of the moving system to fit the source inside the chamber.
- Made 2D drawings for the workshop.

LEARN CLUSTER PRODUCTION: existing source
EXAMPLE: Cu clusters



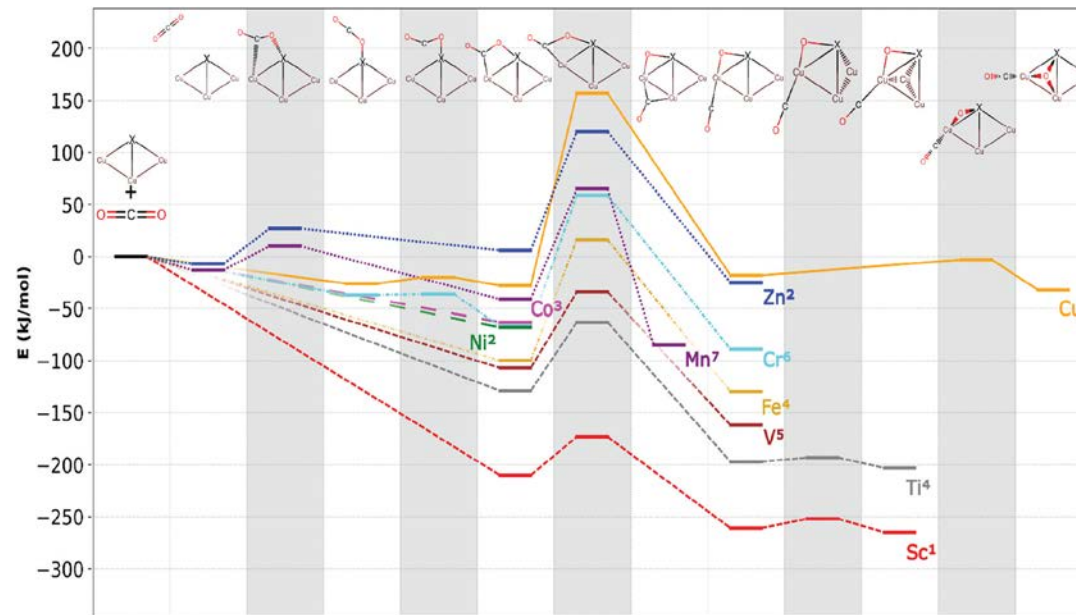
Clusters are sensitive to:

1. Target rod rotation.
2. Laser intensity and focus.
3. Gas pressure.
4. Delay between gas and laser pulse

PLANS FOR THE COMING 12 MONTHS

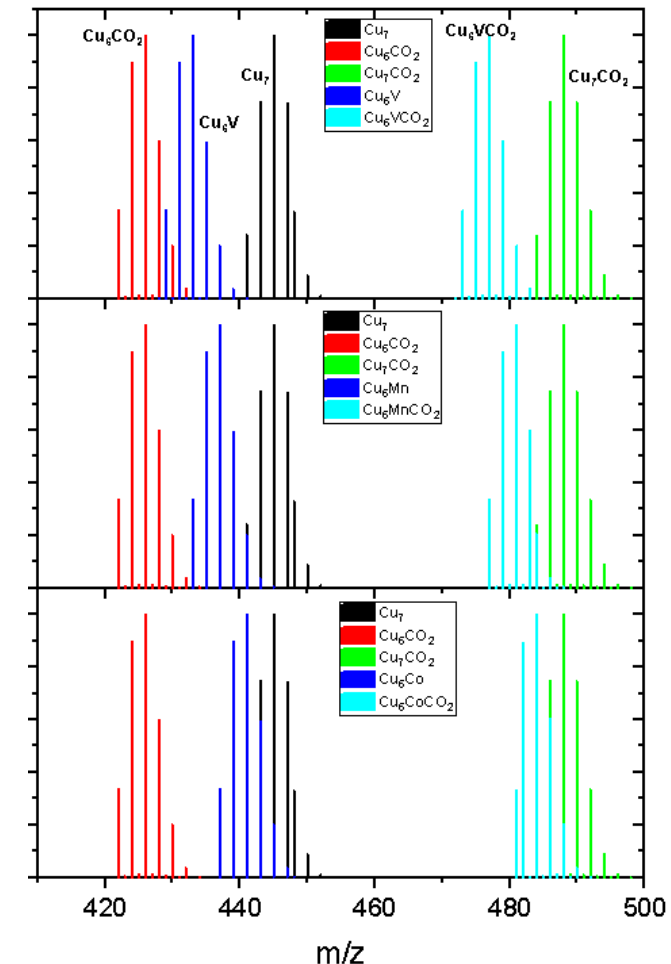
- **Secondment 1: ULM (MAY-JUNE 2022)** on reaction kinetics
- Commission new cluster source
- Spectroscopy of CO₂ activation by 3d TM-doped Cu clusters (beam time June 2022)
- DFT calculations on observed IR spectra (with Barbara, BME Budapest)
- Spectroscopy of H₂ dissociation by 3d TM-doped Cu clusters. (write beam time proposal in May 2022)

1st project: 3d TM doping of Cu clusters lowers CO₂ activation barrier



Höftzl et al., *Phys. Chem. Chem. Phys.*, 2021, 23, 21738–21747

Chose MCu_n^+ (M=V, Mn, Co) clusters based on simulated isotopic distributions.
 Option: isotopically enriched Cu-65



FURTHER TRAINING

CONFERENCE ATTENDED:

- IMM symposium: research pitch



SKILLS TRAINING:

- Wrote beam time proposal (November 2021)
- Social Dutch course I

