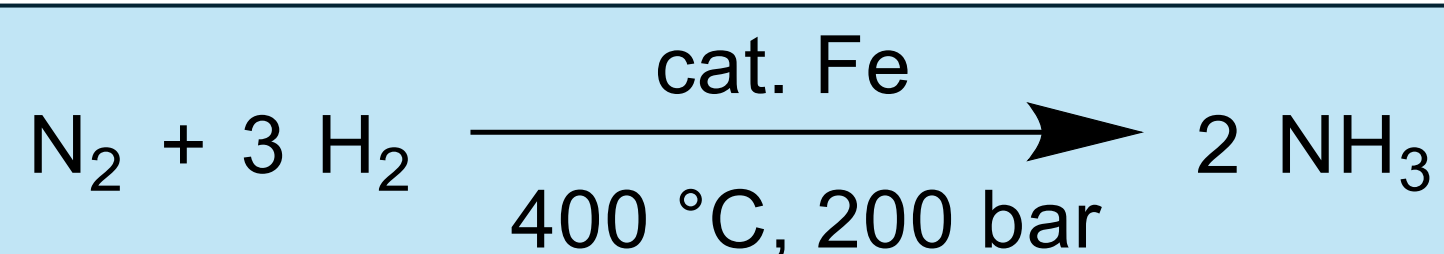


New Samarium(II) Reductants for Ammonia Production

David Stavang Stubhaug and Marco Aurelio Impelluso

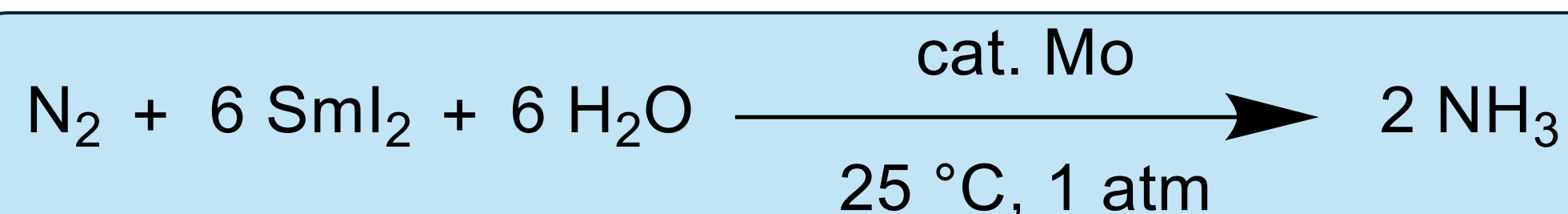
A population of 8 billion depends on Ammonia (NH₃) -- but its production is problematic

Haber-Bosch process:

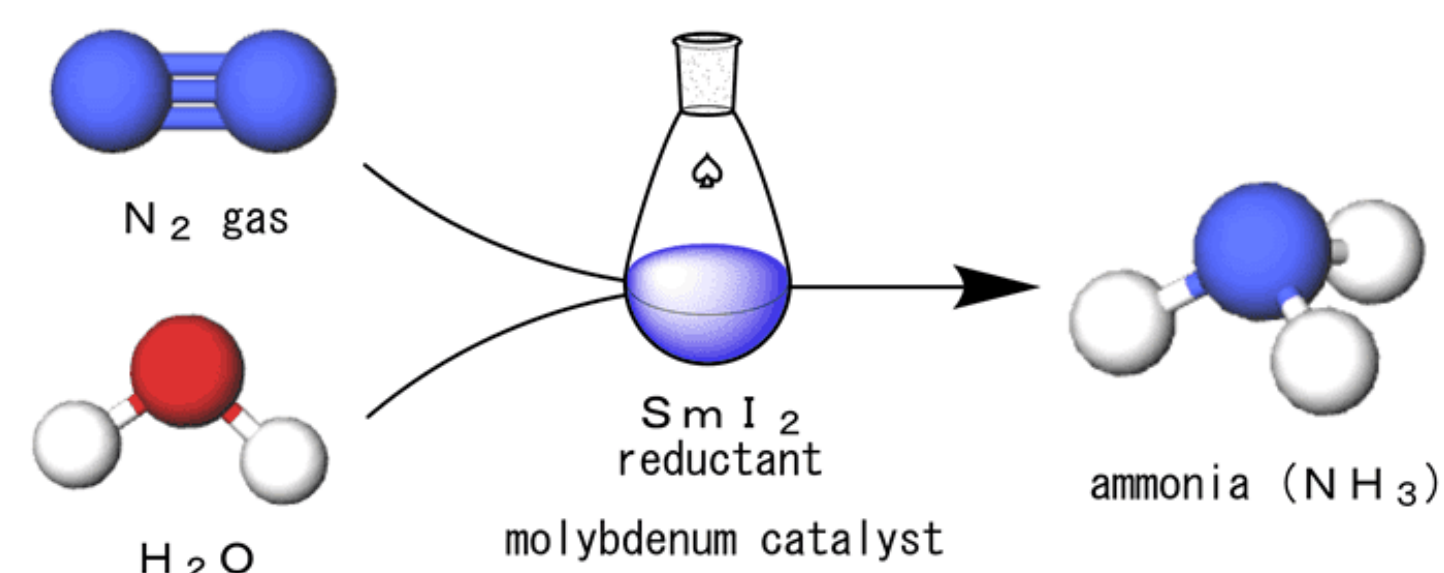


Produces 180 million tons of NH₃ annually, mainly for fertilizers
1,8% of global carbon emissions and 1-2 % of global power usage

Nishibayashi process:



A less energy-intensive, carbon-free alternative
SmI₂ is the bottleneck of the reaction, clustering and inhibiting the reaction

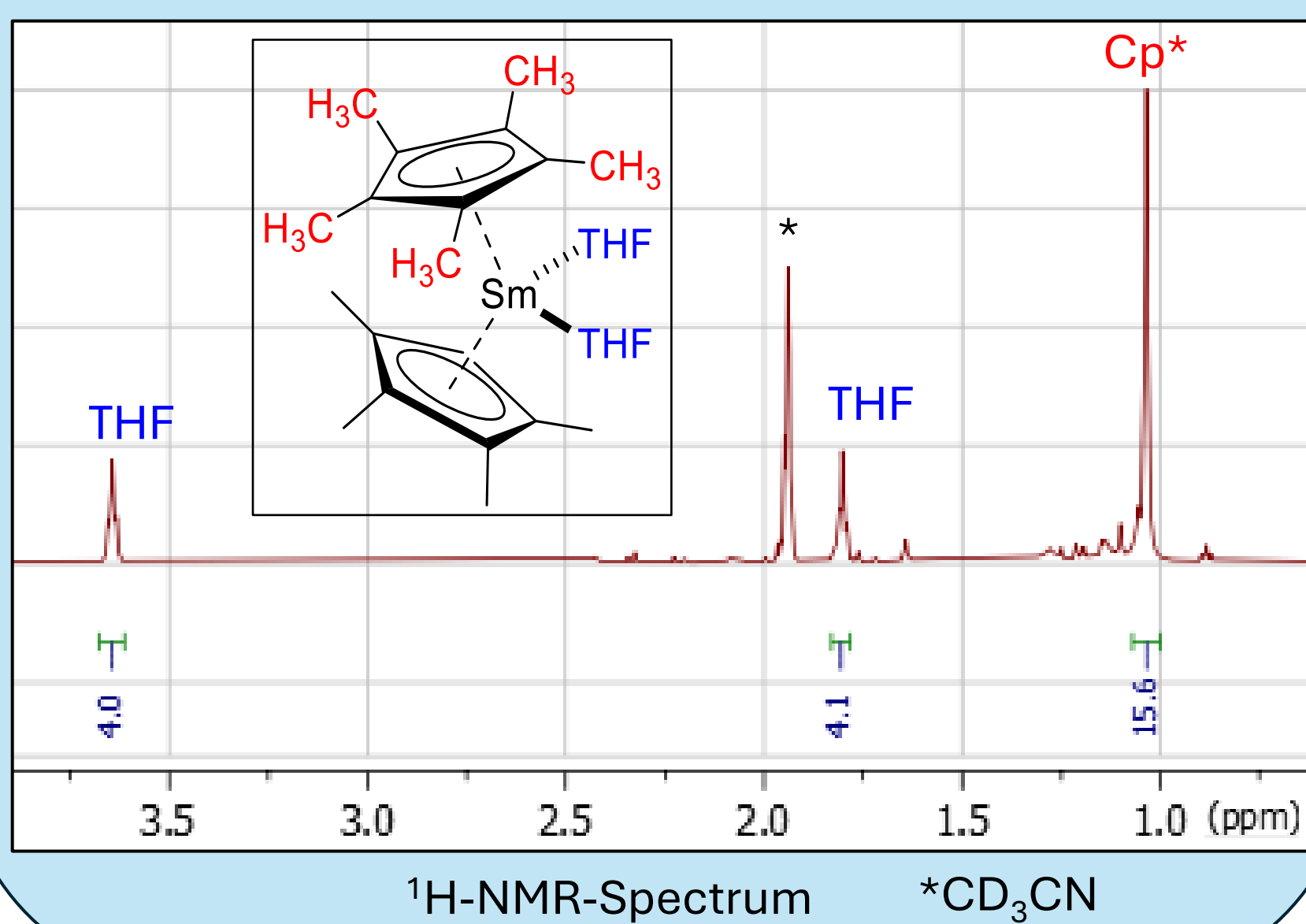
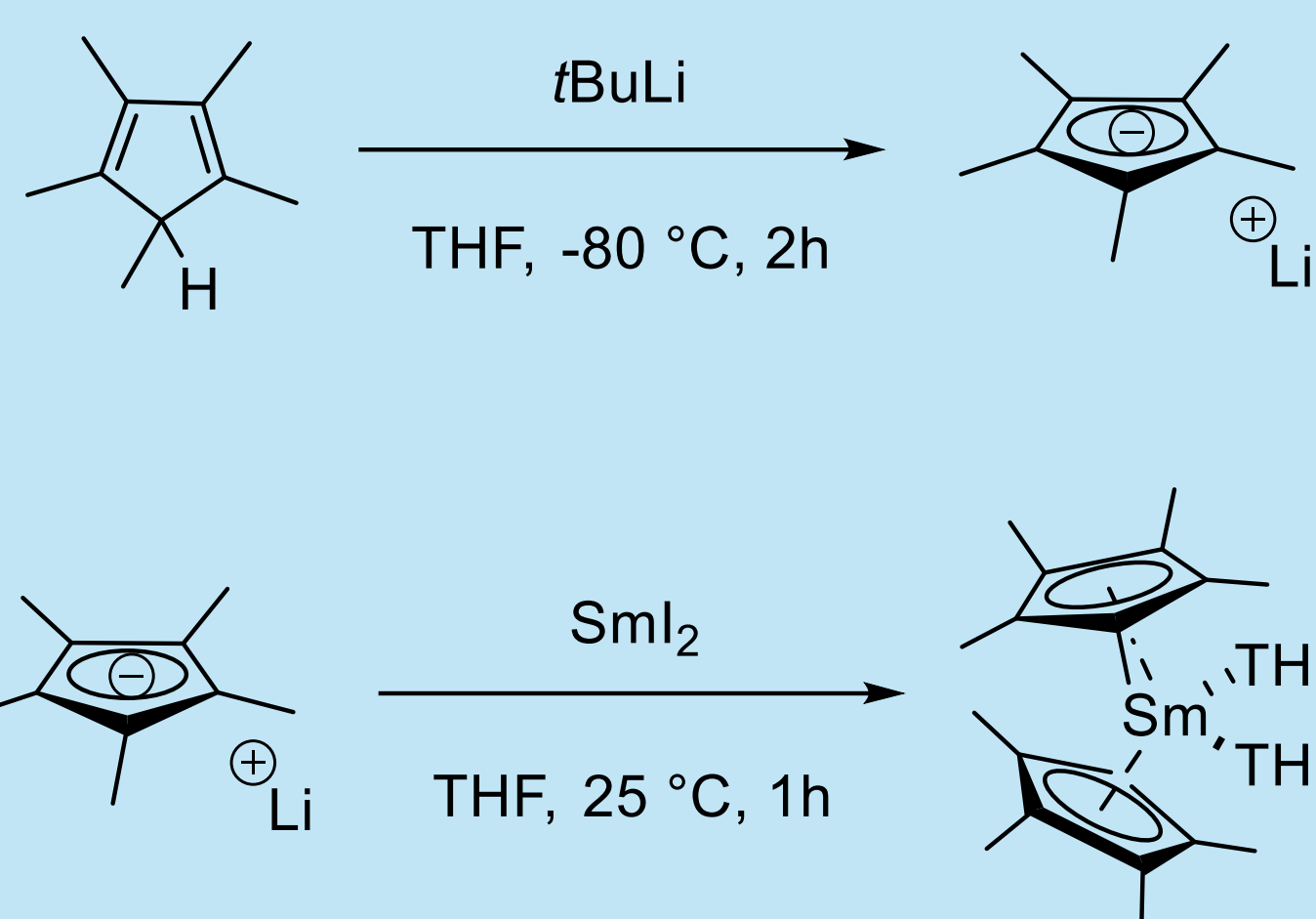


The aim of the project:

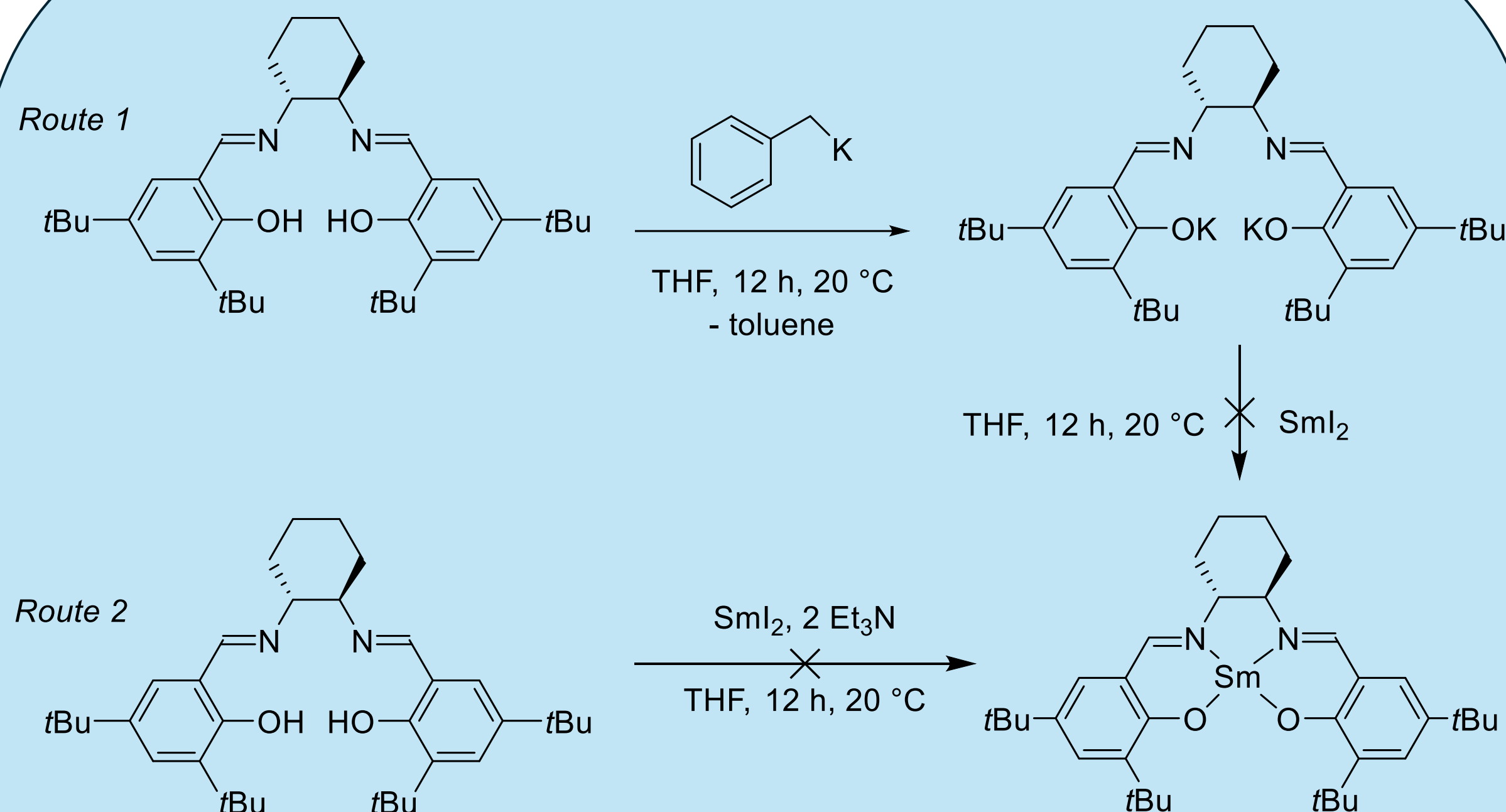
To synthesize bulky samarium-based complexes and determine whether they can be produced at a large scale. The complexes consist of the samarium(II) ion, and one or more ligands.

Synthesis & Analysis:

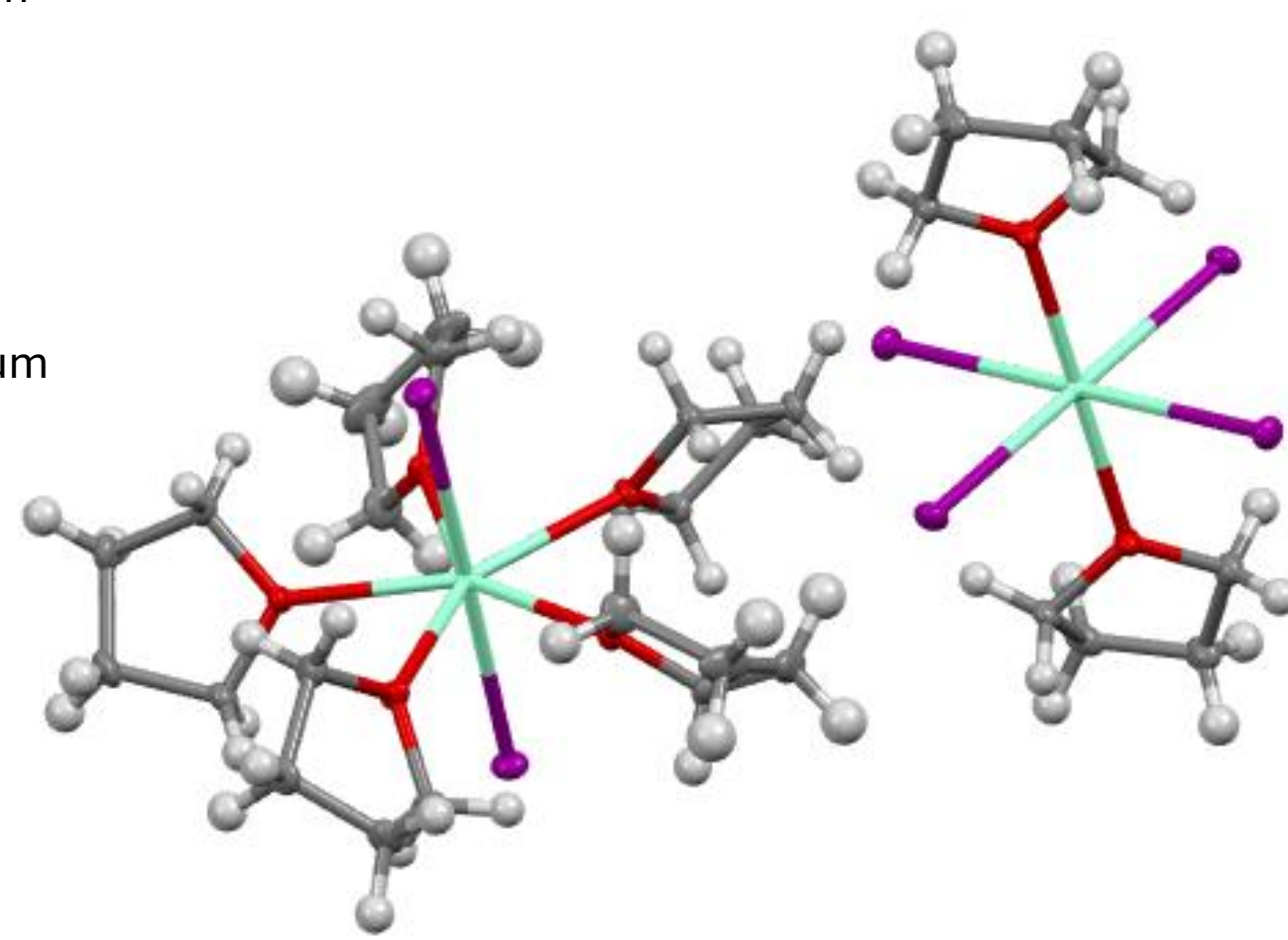
Samarocene chemistry



Salen-samarium chemistry



- Hydrogen
- Carbon
- Oxygen
- Iodide
- Samarium



X-Ray Structure

Route 2 produced crystals in THF solution, which were determined to be Sm(III)-salts.

Conclusion:

Samarocene chemistry:

- The metallocene was synthesized successfully.

Salen-samarium chemistry:

- Attempts to synthesize the samarium(II) salen complex were unsuccessful, yielding only to Sm(III)-salts.
- Other routes for synthesis of samarium(III) salen could be envisioned for further reduction to samarium(II) salen.

References:

- T. Mitsumoto, Y. Nishibayashi, Angew. Chem. Int. Ed.. 2025, 64e202423858. <https://doi.org/10.1002/anie.202423858>
- Y. Roux, C. Duboc, M. Gennari, ChemPhysChem2017, 18, 2606. <https://doi.org/10.1002/cphc.201700665>

Acknowledgements:

We would like to thank the project supervisors: Assoc. Prof. Erwan Le Roux and MSc. Huy g. Nguyen, as well as MSc. Leif Eric Hertwig for the X-Ray analysis.



295.5



UNIVERSITY
OF BERGEN