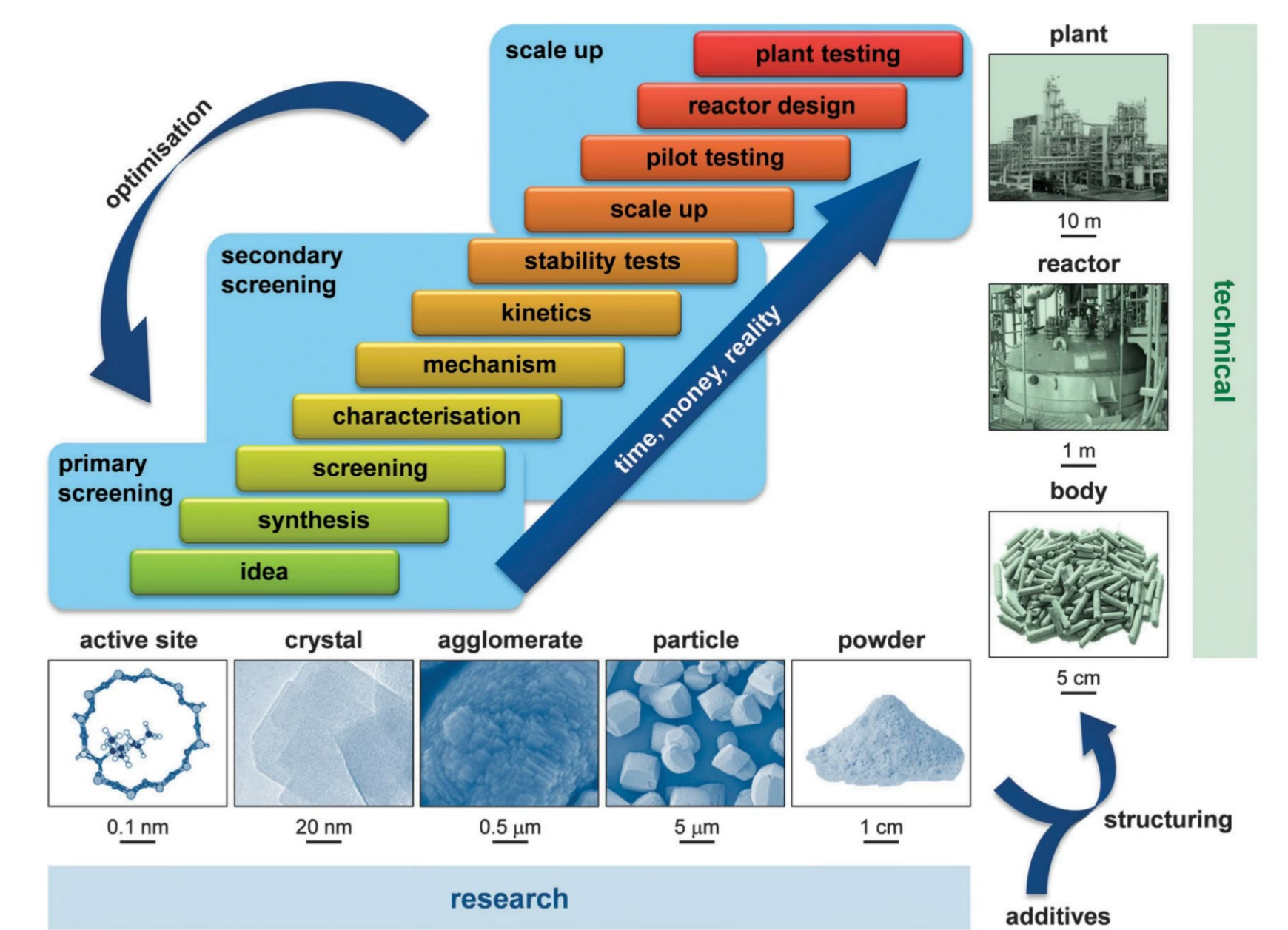


## ABSTRACT

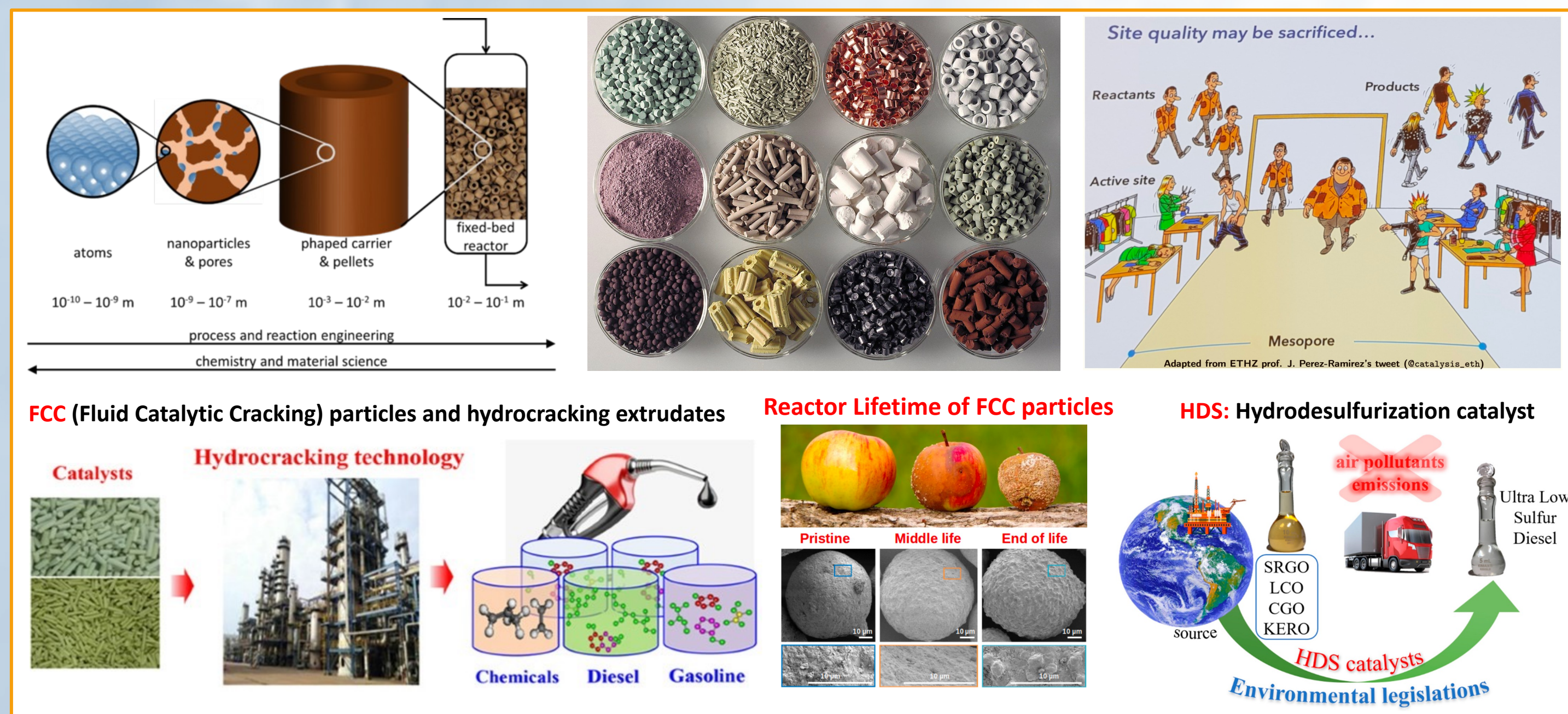
Catalysts are materials that facilitate chemical reactions, enabling the transformation of toxic components into non-toxic forms and playing a crucial role in vehicle fuel cleanup. However, optimizing **industrial (technical) catalysts** presents a significant challenge due to their relatively large, multi-component structures, comprising active phases, supports, and additives. To comprehensively comprehend the intricate relationships between their complex structure and functionalities, it is imperative to characterize their internal structure with high resolution and sensitivity. This approach facilitates the detection of defects or unexpected deposits of harmful materials that may develop within a catalyst's structure during operation, thereby shortening its lifespan. To address this challenge, we developed **Ptychographic X-ray Computed Tomography (PXCT)**, an emerging, non-destructive, 3D X-ray microscopy technique that is revolutionizing the characterization of technical catalysts and other heterogeneous materials. This research project centers on the advancement of knowledge within the field of Physics, with its primary outcomes being applied to the domain of Chemistry.

## MRS

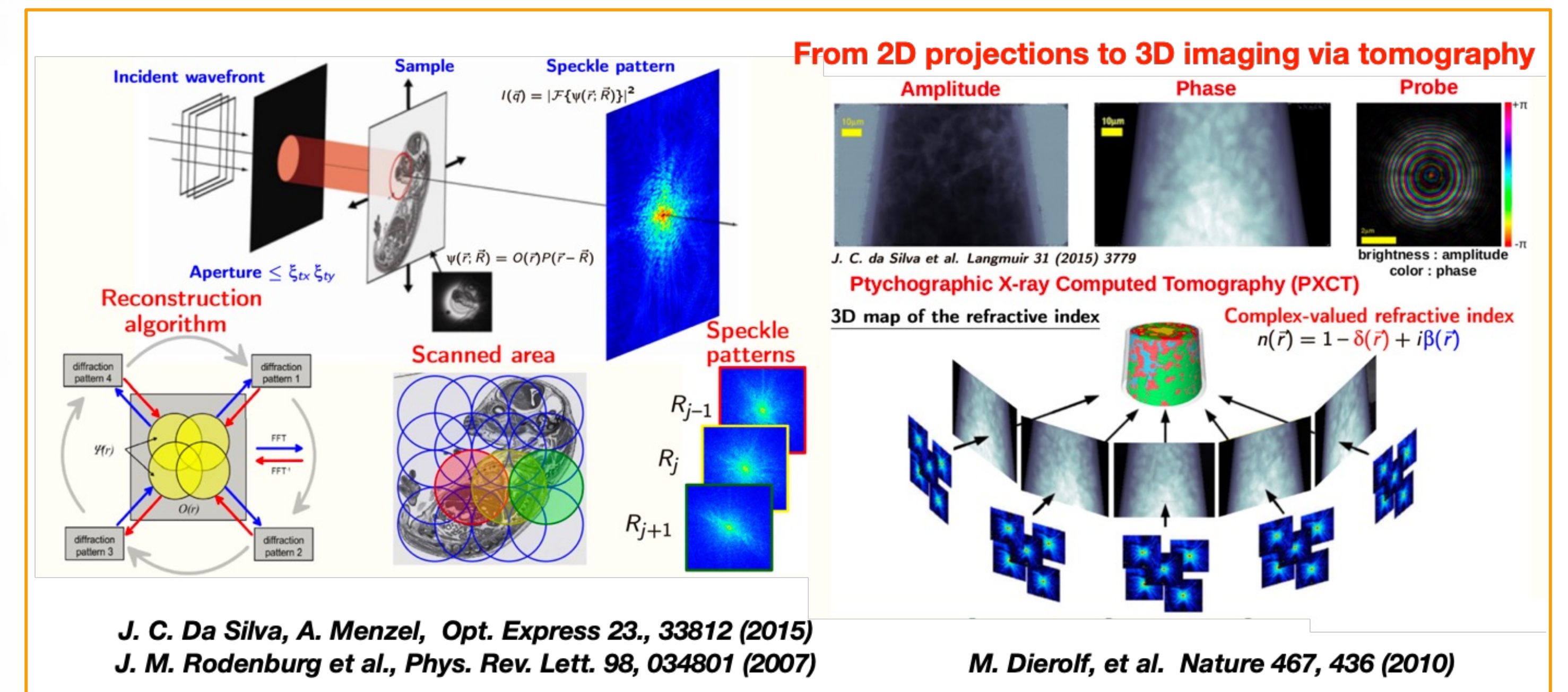


The scale-up process in catalysis industry. Adapted from S. Michell et al., Chem. Soc. Rev. 43, 6094 (2013)

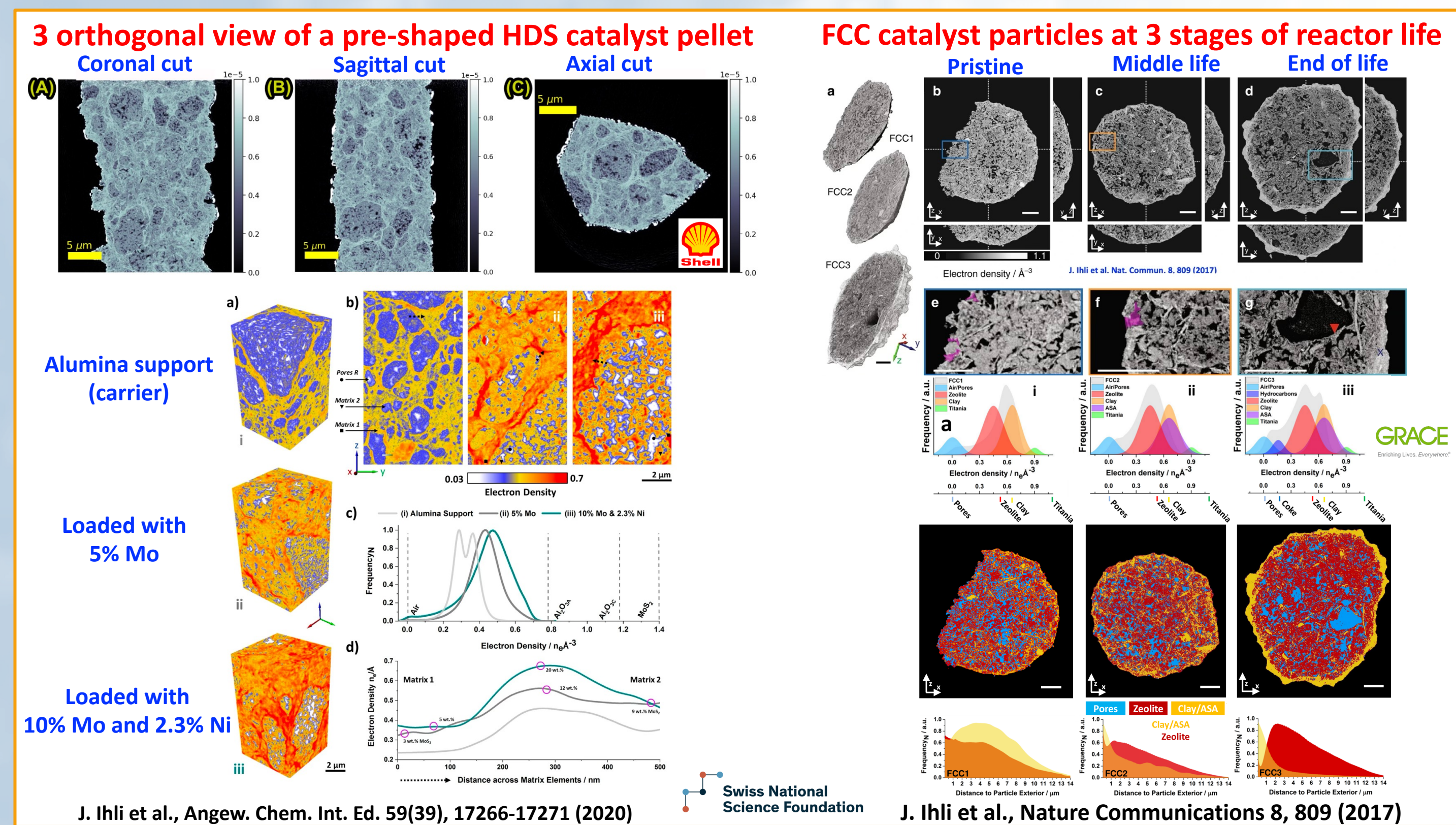
## Technical catalysts: HDS, FCC, hydrocracking



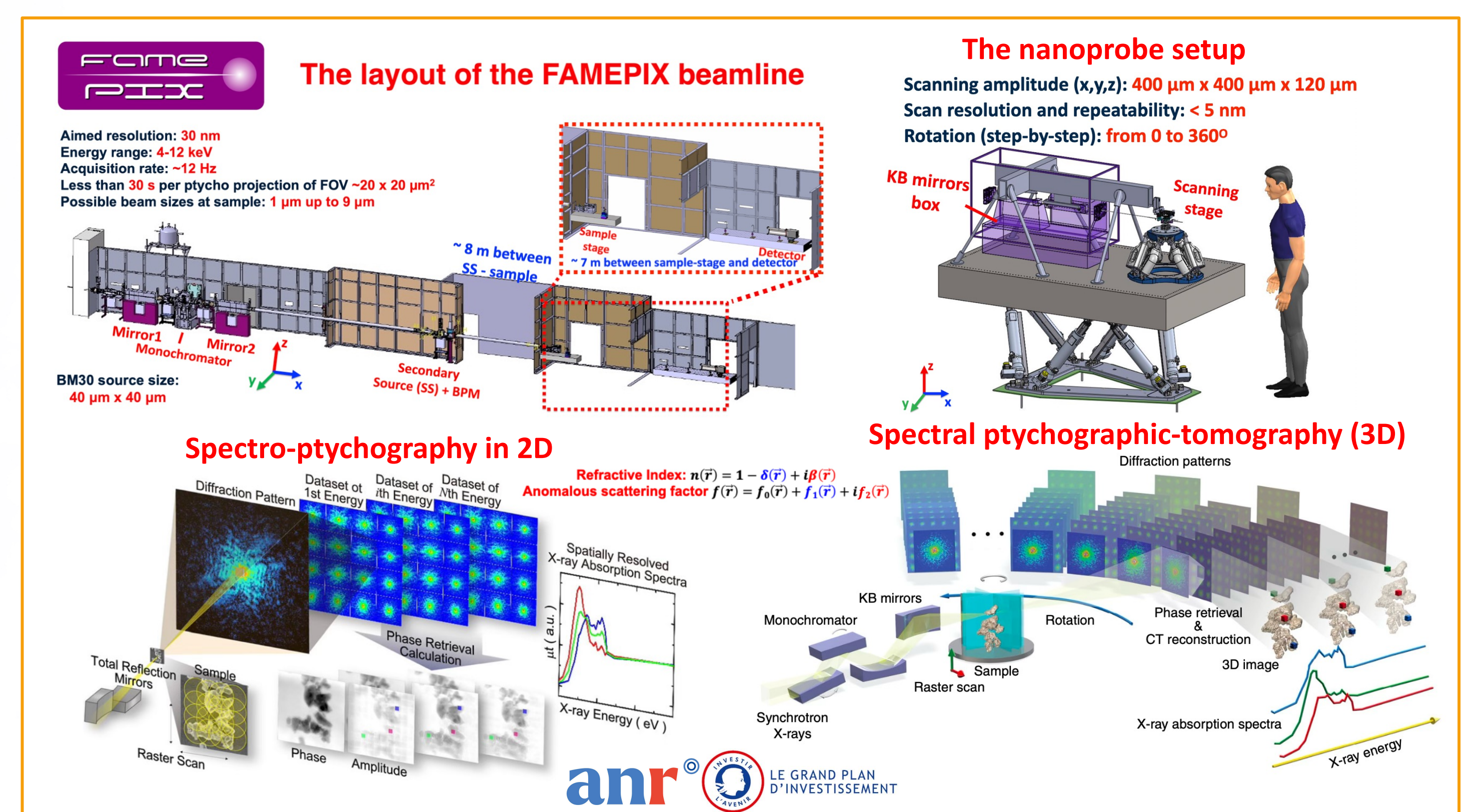
## Ptychographic X-ray Computed Tomography



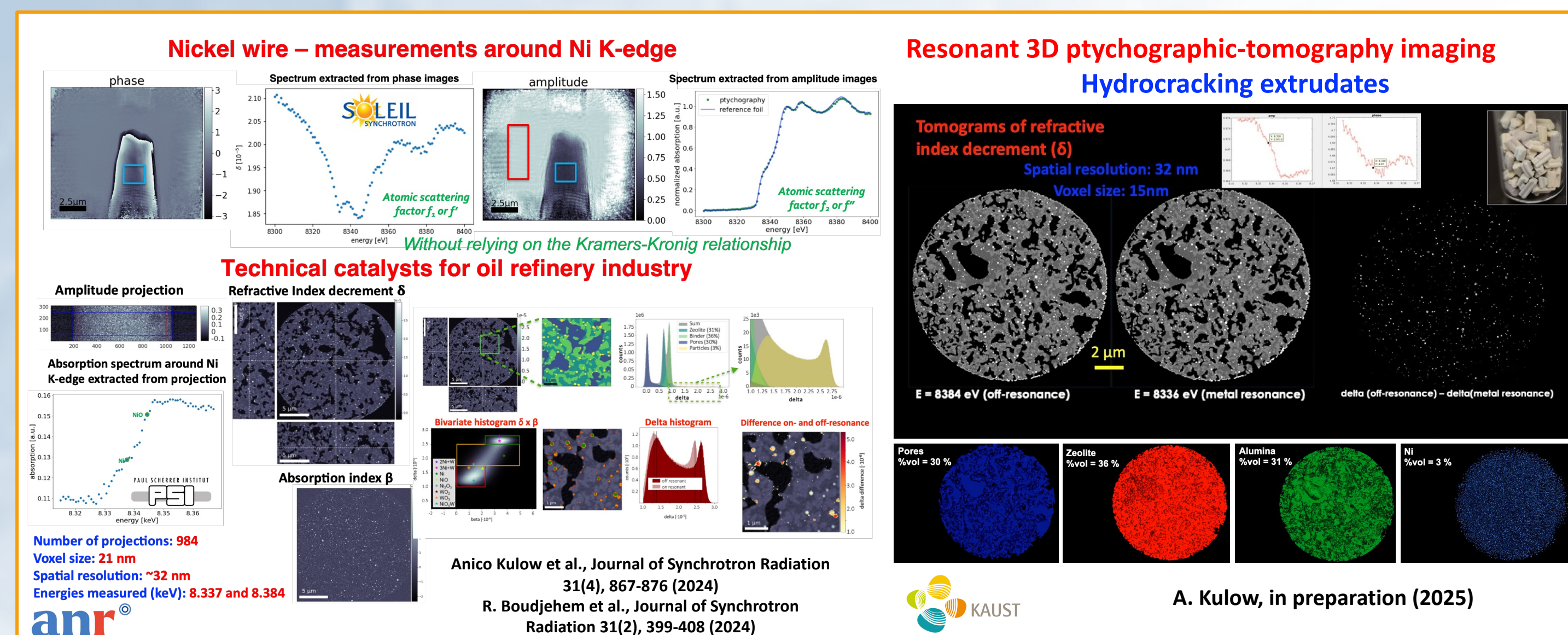
## High-resolution Imaging of technical catalysts



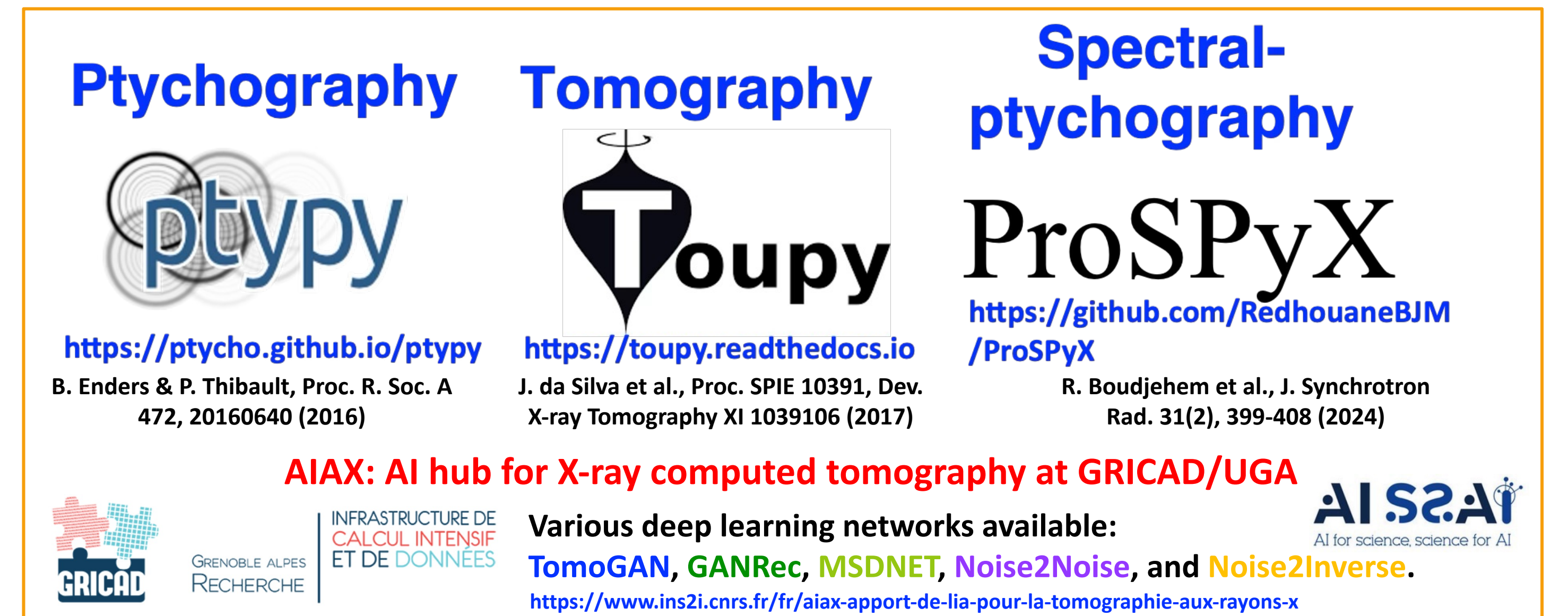
## The 1st French hyperspectral X-ray microscope



## Spectral decomposition and quantification



## Development of open-source data analysis software



## FURTHER READING

- [1] A. Kulow et al., Journal of Synchrotron Radiation 31(4), 867-876 (2024)
- [2] R. Boudjehem et al., Journal of Synchrotron Radiation 31(2), 399-408 (2024)
- [3] J. Ihli et al., ACS Catalysis 11, 8274-8283 (2021).

- [4] J. Ihli et al., Angewandte Chemie International Edition 59(39), 17266-17271 (2020)
- [5] J. Ihli et al., Nature Communications 8, 809 (2017).
- [6] J. da Silva et al, ChemCatChem 7, 413-416 (2015).