During the last decade, with the advent of extremely bright X-rays sources, powerful new X-ray detectors, and efficient X-ray optics, unprecedented studies of hierarchical functional materials such as battery electrodes, fuel cells, and catalysts became possible. This is particularly true for X-ray imaging, where the combination of high spatial resolution, a large field of view, short dwell times, and the capability to obtain spectroscopic information opened the door to analyses correlating chemistry and morphology of, for example, whole catalyst particles used in fluid catalytic cracking (FCC) [1].

FCC is an important process in the petrochemical industry, accounting for 40-45% of worldwide gasoline production. In FCC, catalyst particles are employed to crack large hydrocarbon fractions into more valuable materials, such as gasoline and propylene. The spherical particles with diameters of 50-100 µm are a hierarchically structured porous composite material with pore sizes ranging from micro- (<2 nm) to macro-pores (> 50 nm) and are a typical example for a rationally designed, functional material.

On critical aspect when using powerful imaging techniques for the analysis of such materials is the large amount of collected 2D, 3D, or even 4D information, which has to be put into context with how these functional materials operate. The sheer amount of data that has to be examined often requires a paradigm shift in the way we perform X-ray analysis. In this presentation I will report recent results and developed data analysis concepts from our X-ray imaging studies of catalyst particles, showcasing strengths, challenges, and prospects.

References: