Master thesis or internship

Exploring High-throughput x-ray measurements as enabling technology for sustainable transitions within Engineering Materials and process industry

Background

Sustainable materials and process research and development need to consider the effective use of resources and time to generate the desired novel solutions. Timely material and process analysis are thus important and tools such as synchrotron x-ray characterization can be highly beneficial due to the rapid analysis capability. High-throughput x-ray measurements has the potential to significantly enhance the pace of sustainable materials and process innovations. However, the high-throughput large-scale synchrotron infrastructure measurements are inherently complex, less accessible, and if not used optimal much more costly, than lab-scale tools that exists at many universities, institutes and companies. It is therefore important to develop strategies and plans for how to make use of lab-scale and large-scale high-throughput measurements and when each of them should be used. Also, it is important to have good transferability between lab-scale and large-scale high-throughput measurements. There can be differences in setups, resolutions, etc. and these differences and similarities needs to be properly mapped in order to ensure a streamlined incorporation of both lab-scale and large-scale high-throughput x-ray measurements in the R&I tool portfolio.

Currently it is not well known how the lab-scale and large-scale compares for different types of measurement methods, materials and research questions. Within the competence center Neutron and X-ray science for industrial technology transitions (NEXT) | KTH we therefore aim to map the different measurement methodologies applied to various materials and outline the benefits and drawbacks. Thereafter, recommendations and strategies for how to most effectively use various lab-scale and large-scale tools for effective R&I within NEXT and also for the partners outside of NEXT can be proposed. The overall NEXT project aims to benchmark SAXS, WAXS, XRF, Radiography, Tomography and 3DXRD on lab- and synchrotron-scale. We will initiate this larger work with this Master thesis by starting with the mapping of high-throughput x-ray diffraction measurements for enhanced capability in materials and process innovations for industry.

Aims and objectives

This Master thesis or internship project aims at mapping capabilities of X-ray diffraction (XRD) measurements at lab- and synchrotron-scale for Engineering materials challenges. The activities should lead up to a lab- to synchrotron-scale high-throughput plan, i.e. that proposes a strategy for how to use synchrotron beamtime in the best possible way and when measurements could be more favorable at the lab-scale.

Activities and project timeline

The following activities will be included in the project. The x-ray measurements will be conducted in the home laboratories of partners of NEXT (in Stockholm) and one or a couple of campaigns at international partner labs (e.g. Hamburg, Germany and Shenzhen, China). The detailed plans for the measurements will be clarified before the start of the thesis.

Activity	2024/2025				
	Month 1	Month 2	Month 3	Month 4	Month 5
1. Literature survey					
2. Planning of beamtimes					
3. Sample preparation					
4. X-ray measurements					
5. Analysis					
6. Reporting					
Visits to x-ray labs		*	*		

Starting date: As agreed in autumn 2024 or beginning of 2025.

Duration: 5 months
Location: KTH and visit/-s to national and international partner/-s
Supervisor: Peter Hedström, pheds@kth.se