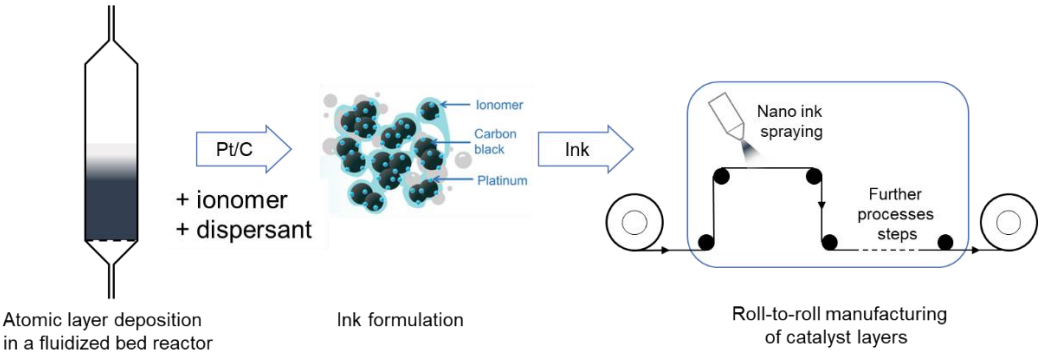
M.Sc. Thesis Opportunity: Date: May/2023

Scalable Fabrication of Catalyst Layers for the Energy Transition

Background & Motivation

A key issue of the ongoing energy transition is usage and/or storage of excess electricity from fluctuating renewable sources. At the same time, many substances that today are derived from petrochemical sources must soon be replaced in order to achieve net zero carbon dioxide emission. Power-2-X technology addresses both of these issues and an essential component of the respective systems are catalyst layers (CLs), as for example in PEM electrolysers. Given the scale of the anticipated production output needed for CLs, every new manufacturing concept must take into scalability and consumption of raw materials, while not compromising performance.



The Project

We envision a fabrication process chain for CLs that integrates atomic layer deposition in a fluidized bed reactor[1] (ALD-FBR) and roll-to-roll manufacturing.[2] ALD-FBR allows for an efficient use of precious raw materials such as Platinum (Pt) that is deposited sparsely onto a host material (e.g. carbon). The Pt-loaded carbon (Pt/C) is then dispersed in an ink formulation and finally deposited onto a flexible substrate using nano ink spraying in a roll-to-roll process. To further elucidate the scalability and economic potential of the approach, the following tasks and questions shall be elaborated in an M.Sc. thesis project:

- Modelling the throughput and optimize for efficiency of the process chain.
- Reactor engineering and integration.
- Techno-economical assessment of the approach.

The M.Sc. project is embedded in a larger project, that includes both experimental and theoretical work with the goal of bringing ALD-fabricated Pt/C catalyst to real-world applications. This project is suitable for students of Chemical Engineering with an interest in catalysts, modelling and the energy transition.

Interested?

Contact us at p.m.piechulla@tudelft.nl for more information! The project will be supervised by dr. Peter Piechulla and prof. dr. Ruud van Ommen (PPE/ChemE/TNW and e-refinery).

References

(1) Grillo, F.; Van Bui, H.; Moulijn, J. A.; Kreutzer, M. T.; van Ommen, J. R. Understanding and Controlling the Aggregative Growth of Platinum Nanoparticles in Atomic Layer Deposition: An Avenue to Size Selection. *J. Phys. Chem. Lett.* **2017**, *8* (5), 975–983. https://doi.org/10.1021/acs.jpclett.6b02978.

(2) Bapat, S.; Giehl, C.; Kohsakowski, S.; Peinecke, V.; Schäffler, M.; Segets, D. On the State and Stability of Fuel Cell Catalyst Inks. *Advanced Powder Technology* **2021**, *32* (10), 3845–3859. https://doi.org/10.1016/j.apt.2021.08.030.