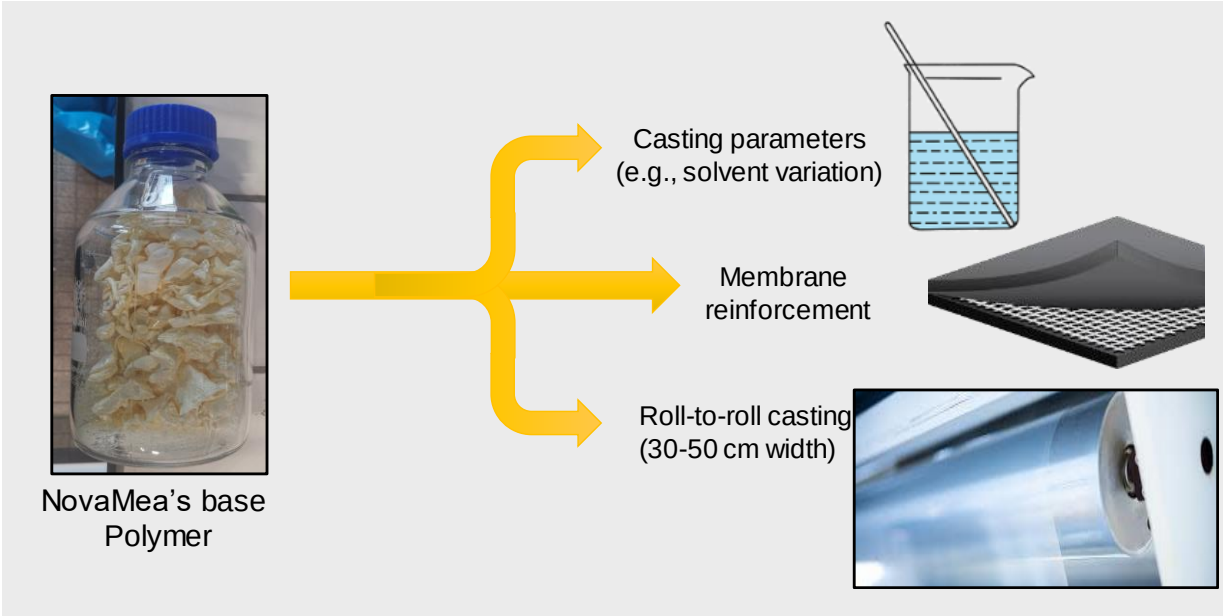
Scaled-Up Manufacture of Membranes and Ionomers for the energy Transition (SUMMIT)

The project, SUMMIT, provided the collaborative framework and infrastructure to scale up production of state-of-the-art anion exchange membranes from the lab to the pilot roll-to-roll scale.

THE CONTEXT

The SUMMIT democase centered around the development of high-performance anion exchange membranes (AEM) for water electrolysis, which plays a crucial role in the production of green hydrogen. NovaMea, a cleantech start-up spun out from the École Polytechnique Fédérale de Lausanne (EPFL), in collaboration with the membrane group of Prof. Dr. Mathias Ulbricht from UDE, aimed to scale up membrane production processes from lab-scale to industrial levels. NovaMea's innovative AEM technology holds significant potential to reduce reliance on expensive, precious metal catalysts while enabling high current density and compatibility with intermittent renewable energy sources such as solar and wind power. At the heart of the project is the challenge of transitioning from small-scale, sheet-to-sheet membrane casting methods to a continuous roll-to-roll production process. Currently, NovaMea's membranes are produced at relatively small areas, but to make the technology commercially viable, large-scale production could be achieved without compromising the membrane's favorable electrochemical properties. To this end, the INNOMEM project provided access to pilot-line facilities and expert resources, allowing for the necessary scale-up.



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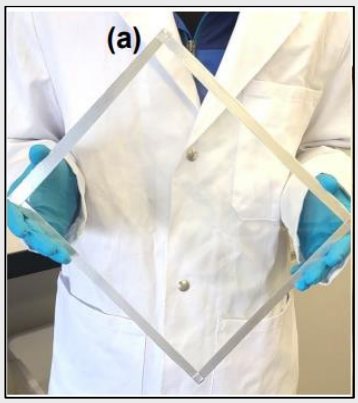
THE CHALLENGE

NovaMea SA faced the challenge of scaling up its roll-to-roll membrane production process from a lab-scale to industrially relevant levels, specifically to a width of approximately 50 cm, to advance its anion exchange membrane (AEM) water electrolysis technology. This scale-up is crucial for making green hydrogen production more affordable and commercially viable. The company needed to overcome technical and manufacturing barriers, including optimizing critical parameters such as drying time, solvent compatibility, and membrane reinforcement, and must effectively leverage COATEMA pilot line facility to address these challenges and achieve the mechanical durability and consistency required for large-scale applications.



Current scale of membrane fabrication via sheet-to-sheet casting

Target scale of membrane fabrication via roll-to-roll casting

THE RESULTS

- *Successfully optimized key parameters such as drying conditions in lab-scale and during roll-to-roll casting.*
- *Fabrication of good-quality unsupported membrane at 20 * 100 cm^2.*
- *Successfully identified optimal reinforcement strategies for NOVAMEA's polymer, with porous support and treatment process, showing the best results for polymer penetration.*
- *Successful pilot-line trials using porous substrate leading to samples of reinforced NovaMea AEM.*

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CONCLUSION

The project made significant progress across its phases despite initial delays. We successfully completed lab-scale casting experiments, with optimizing key parameters such as polymer concentration, casting speed and drying conditions. Furthermore, reinforcement strategies were established, with a porous support identified as best choice. The optimized conditions for casting unsupported membranes and feasible conditions for casting supported membranes were used for pilot-line roll-to-roll casting trials, though delayed and limited in terms of size of resulting samples, due to limited amount of polymer. Nevertheless, in pilot-line trials, the influence of varied process parameters such as cast thickness, casting speed, and drying conditions was evaluated. Membrane performance metrics like ion-exchange capacity, membrane conductivity, tensile strength indicate that the resulting materials are competitive with state-of-the-art anion-exchange membranes for alkaline water electrolysis.

TECHNIQUES USED

To achieve the project's goals, several key services and resources have been utilized. The polymer obtained from NOVAMEA was utilized to cast membranes in both lab-scale trials and pilot-line trials. Additionally, various lab-scale facilities, such as the casting unit and membrane performance testing equipment from Prof. Mathias Ulbricht's group at UDE, were used. The COATEMA pilot-line facility at UDE that had been upgraded during INNOMEM for roll-to-roll casting of ion-exchange membranes was employed for scaling up membrane production.

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