3D printing antifouling properties into nanoporous membranes

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Nanoporous membranes are a pivotal technology in supporting the future growth of water purification, desalination, and wastewater treatment industries owing to their ability to selectively remove contaminants at the molecular level. However, they struggle with limited fouling resistance while trying to achieve high permeance [1]. Meanwhile, standard fabrication methods face challenges with homogeneity, waste production, and narrowing the pore size distribution at low costs which is essential to water applications [2]. In contrast, incorporating nanoporosity into 3D-printed materials through Digital Light Projection (DLP) is promising as it allows precise control over membrane structure with high geometry customization and minimal waste [3]. Within this context, we propose a novel strategy that relies on the advantages of UV-based additive manufacturing to design and produce nanoporous ultrafiltration polymeric membranes with organized porous micropatterns that promote not only antifouling properties but also increased flux and recovery due to increased shear stress and turbidity control. This approach enables the simultaneous production of the membrane and the pattern, increasing fabrication efficiency and further reducing waste generation. Furthermore, we showcase that the technique can be successfully applied to commercial bench-top 3D printers, contributing to lower production costs. The patterned membranes were tested in cross-flow filtration setups for common proteins fouling and rejection, as this technology is extremely valuable for downstream bioprocessing waste recovery. As such, this talk aims to discuss how the production of 3D-printed nanoporous patterned membranes represents a new step towards highly specialized membranes that achieve high separation efficiency while having an increased life span.

References

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Figures

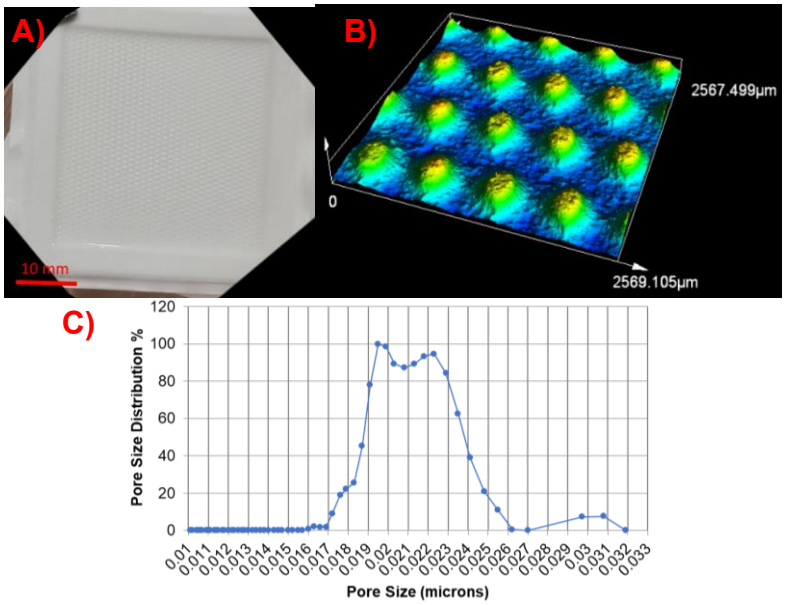

Figure 1: 3D printed patterned membrane (a), profilometry topography (b) shows off-set hill-like pattern design in detail and porometry (c) highlights nanoporosity of the material.