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Towards Correlative X-Ray Tomographic Imaging Of Membranes For Improving Food Processing

Content

In recent years the need for shifting our food system towards more plant-based proteins has become more and more apparent. The key reason for this shift is the economic and sustainable recovery of plant proteins from valuable, yet underutilized agricultural waste streams for use in food applications. For highly selective energy and resource-efficient separation processes, membrane filtration can play an important role in realizing this shift.

The first successful membrane technology in the food industry was the recovery of proteins from whey, which was until the 1970's a major disposal challenge for the dairy industry. Using ultrafiltration (UF) membranes, it was suddenly possible to concentrate and desalt whey proteins. Based on this success story, membrane processes established themselves for the concentration and purification of many products in the food industry. However, clogging of the membrane during the filtration process, so-called membrane fouling, is still a major challenge.

Membrane fouling alters the separation performance during operation. It may be caused by the deposition of suspended and dissolved substances on the membrane surface, thereby forming a cake or gel layer, thus blocking the pore openings, or causing adsorption on the surface and on the pore walls. Membrane fouling can only be overcome by regular chemical cleaning, which in turn leads to plant down time, membrane aging, consumption of high-quality drinking water and the generation of huge amounts of waste water.

Thus, a comprehensive understanding on membrane fouling on a fundamental level is needed. One approach to generate in depth knowledge, is to examine changes due to fouling and cleaning of the inner structure of the membranes on a micrometer to nanometer scale using correlative X-ray tomographic imaging techniques, including microtomography, full-field nanotomography, holographic nanotomography and ptycho-tomography. This presentation will give an overview of the possibilities of X-ray tomographic imaging methods for membrane technology to improve the operation of membrane processes in the food industry More specifically an example of UF for the separation of rapeseed proteins from the press cake of the rapeseed oil production will be presented, including the need for sample preparation by Focused Ion Beam (FIB).

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