ALBERTA INNOVATES

CLEAN RESOURCES

ENVIRONMENTAL INNOVATION

WATER INNOVATION

Next Generation Water Purification Membranes with High Thermal Stability and Antifouling Properties

Membrane separation processes are attractive methods for wastewater treatment due to their distinct advantages over conventional techniques. However, the high susceptibility of membranes to fouling has restricted the development of sustainable and energy-efficient membrane processes. This research project will overcome this challenge by developing antifouling membranes using advanced functional nanomaterials called star-shaped block copolymers. These nanomaterials adhere firmly to the underlying substrates and effectively change the surface chemistry of the substrates, thus increasing fouling resistance without sacrificing permeation properties. These new materials are cheaper, more thermally tolerant and synthesized by a more straightforward and highly controlled process.

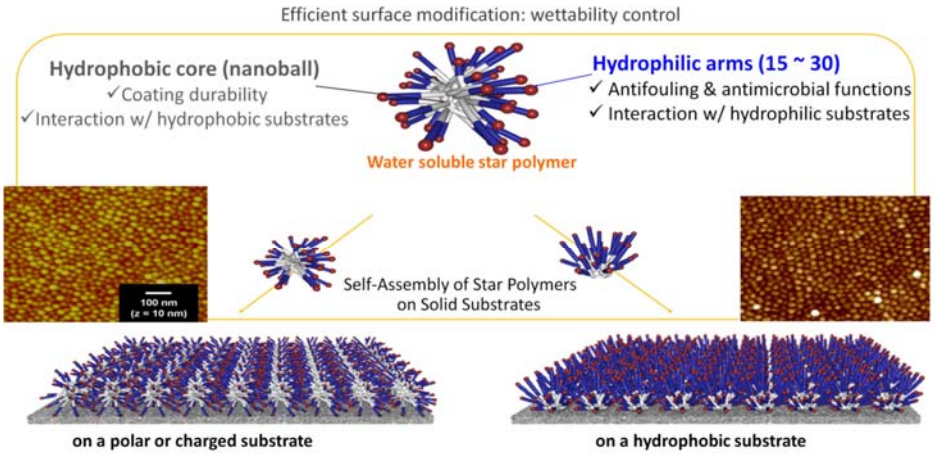

Fig. 1: Chemical Structure of Star-Shaped Block Copolymers and Attachment to Various Surfaces

FUNDING DETAILS

RECIPIENT:
University of Alberta

PARTNERS:
COSIA, NSERC

TOTAL BUDGET:
$453,000

AI FUNDING:
$198,000

PROJECT DATES:
FEB 2023 – APR 2026

PROJECT TRL:
Start: 4
End: 6

APPLICATION

The Alberta's oil sands industry is the primary receptor of the technology. The developed anti-fouling membranes will be applicable to other industrial waters, including food processing and pulp/paper.

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PROJECT GOALS

The primary objective of this project is to develop an innovative star-shaped block copolymer (SP) architecture from an inorganic silica nanoparticle (SiO2NP) core, thereby significantly simplifying the synthesis and enabling scale-up at much lower costs. The second objective of this project is to incorporate these novel silica-based SPs onto membrane surfaces to enhance their fouling resistance and thermal stability.

BENEFITS TO ALBERTA

- Reduced make-up water requirements for SAGD production (5-10% improvement in water use efficiency).
- Improved energy efficiency for SAGD production (5-20% reduction in GHG emissions).
- Potential to roll out these benefits to other industries.
- Potential for use in rural and remote communities.

4 Students Trained

1 Patent

3 Publications

5-10% Future GHG Reduction / bbl In-Situ Oil

1 Project Job

5 Future Jobs

CURRENT STATUS

MAR 2023

After years of collaboration between the University of Alberta, IBM Research-Almaden, and NRC Nanotechnology Research Centre, the team has completed the synthesis of IBM-patented materials and developed surface-modified membranes using these materials. This project aims to expand the scope of technology to a new generation of cost-efficient star block copolymers that can improve both thermal stability and fouling resistance of membranes, making them particularly suitable for treating challenging wastewater at extreme thermal and chemical conditions.