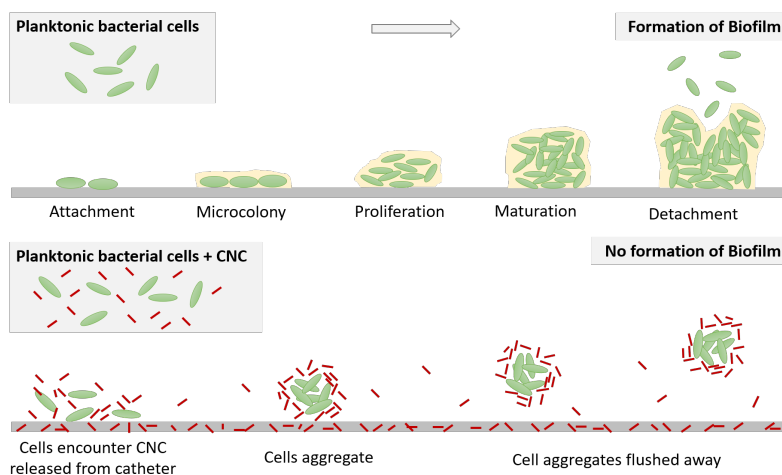# Cellulose Nanocrystal Hydrogels as an Effective Tool for Biofilm Formation Inhibition on Medical Devices: a Step Towards Green Non-Adhesive Catheters

Build upon our recent breakthrough discovery that a cellulose nanocrystal (CNC) based hydrogel prevented bacteria adhesion and biofilm formation on solid surfaces, the present work focuses on formulating hydrogel products with controlled CNC release for effective inhibition of bacterial adhesion on biomedical materials. The goal of this study is to optimize CNC-based hydrogel formulation to achieve strong, long-lasting CNC hydrogel materials with improved control in CNC release and hydrogel dissociation and dissolution. This project will generate highly competitive products in the medical markets, where infection preventative materials are in high demand.

FUNDING DETAILS

RECIPIENT:
University of Alberta – Yang Liu

PARTNERS:
TEC Edmonton

TOTAL BUDGET:
$300,000

AI FUNDING:
$300,000

PROJECT DATES:
September 2018 – August 2020

PROJECT TRL:
Start: 3
End: 5

APPLICATION

New products for infection preventative coating materials for medical devices will be developed in this project using optimized CNC based hydrogel products. The existing commonly used coating strategies for bacterial adhesion inhibition often fail due to the formation of bio-produced conditioning films on coating surfaces. In contrast, the products developed in this study prevent bacterial adhesion on catheters or other types of medical surfaces via CNC induced microbial aggregates and will not cause any antimicrobial effects.

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PROJECT GOALS

- Develop new medical products that prevent bio-adhesion and reduce risk of urinary tract infection in catheter users.
- Deposit silver nanoparticles onto CNC surfaces by templating technology for enhanced biofilm formation inhibition to further examine the potential of applying CNC to inhibit bacterial adhesion.
- Explore the options to minimize hydrogel dissociation from catheter surfaces by tailoring hydrogel composition and/or surface carboxyl groups and length of CNC particles.
- Optimize the formulation of hydrogels using CNC for effective long-lasting hydrogel coating on catheter surfaces.

BENEFITS TO ALBERTA

- Development of new antimicrobial catheters answers the call of the "Prevent CAUTI" initiative, launched by Alberta Seniors Health Strategic Clinic Network.
- Providing green non-adhesive catheters will benefit the users by expanding product choices in the current catheter market.
- Development of value-added products from CNC ensures that Albertans, even Canadians profit from our Research and Development as well as infrastructure investments in CNC production.

2 Publications

3 Students Trained

1 New Product

CURRENT STATUS

APRIL 2020

This project combines alternating processes of materials development for CNC-based hydrogel and efficiency evaluation of anti-adhesion effects. Nine types of CNC-based hydrogel materials were developed and tested, and the team have now identified three types with superior controlled CNC release. Moving forward, the team will complete the characterization and examination of the anti-adhesion effects of the CNC hydrogels and will explore further the possible optimization of hydrogel formulation.