ALBERTA INNOVATES

# CLEAN RESOURCES

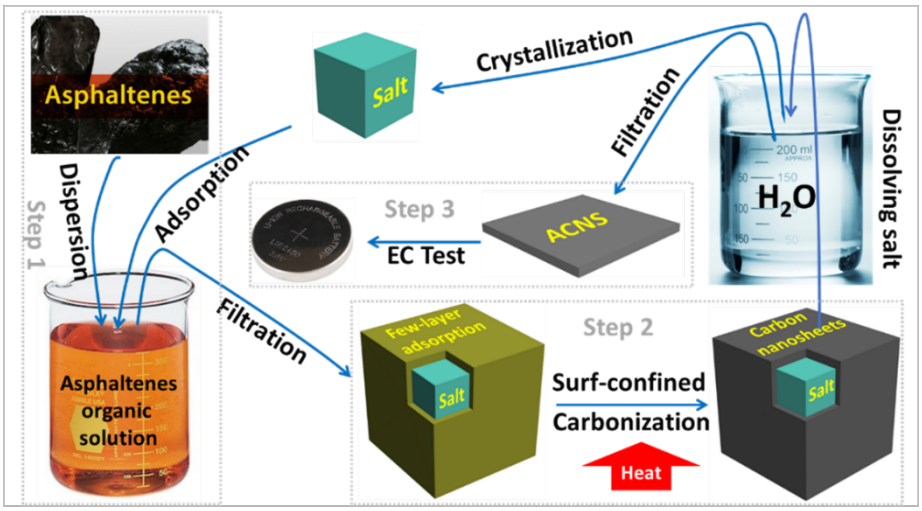
## ADVANCED HYDROCARBONS

INNOVATIVE HYDROCARBON PRODUCTS - BITUMEN BEYOND COMBUSTION

FUNDING DETAILS

# Low-cost Process of Converting Asphaltene into Valuable Graphene-like Materials

Bitumen is rich in heavy, difficult to process components called asphaltenes. Upgrading and refining converts these asphaltenes into lighter fractions for fuel application, and low-value coke. Instead of producing fuels, the proposed project is aimed to develop a green, scalable, and economic process of converting asphaltenes separated from bitumen into graphene-like carbon nanomaterials with a market value up to ~$50/g. As feedstock to make carbon materials, the aromatic nucleus in asphaltene becomes an essential advantage: it minimizes the reorganization of the C-C bonds required to form a graphitic structure with applications as battery and electrode materials.




**RECIPIENT:**
University of Alberta

**PARTNERS:**
NSERC and Institute for Oil Sands Innovation

**TOTAL BUDGET:**
$345,000

**AI FUNDING:**
$172,000

**PROJECT DATES:**
MAR 2019 – FEB 2021

**PROJECT TRL:**
Start: 2
End: 4

## APPLICATION

The early stage of commercialization will be focused on the domestic market in Canada and the high-end applications, such as energy storage and electrocatalysts. These applications are less sensitive to the relatively high cost before mass production. After achieving full commercialization and mass production, we will explore the international market, especially in the USA and China.

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## PROJECT GOALS

The project aims to develop a scalable and low-cost procedure to convert asphaltenes into graphene-like carbon nanosheets, targeting at the fast-expanding energy storage and conversion market. Our scientific goal is to achieve as thin as possible carbon nanosheets for the maximal value. At the end of the project, we expect to achieve the following goals:

- Fabricating high-quality asphaltene-derived carbon nanosheets with thickness no larger than 2-5 nm
- Achieving a production capacity of 10g/patch using lab equipment
- Demonstrating the application of the nanosheets as battery electrodes and electrocatalysts

## BENEFITS TO ALBERTA

The proposed work is to explore a high-value usage of asphaltene to fabricate graphene-like carbon materials, which are much more valuable than the starting bitumen. This research has significant potential benefits that include:

- New products derived from oilsands production
- Diversification of Alberta industry into high-value manufacturing of battery electrodes and electrodes for electrolytic processing
- Training of students in new materials technologies

**3 Publications**

**2 Students Trained**

**2 Patents**

**2 Project Jobs**

**2 New Products/Services**

**CURRENT STATUS**

### May 2020

The research team has developed a method to fabricate asphaltene-derived carbon nanosheets as thin as 4nm with a specific surface area up to 500 m2/g. The nanosheets show clear thickness-dependent performances when used as battery electrodes. As electrocatalysts, the nanosheets exhibit intrinsic catalytic activity for oxygen reduction and oxygen evolution reactions likely due to the heteroatoms in single-atom form and edge plane sites.