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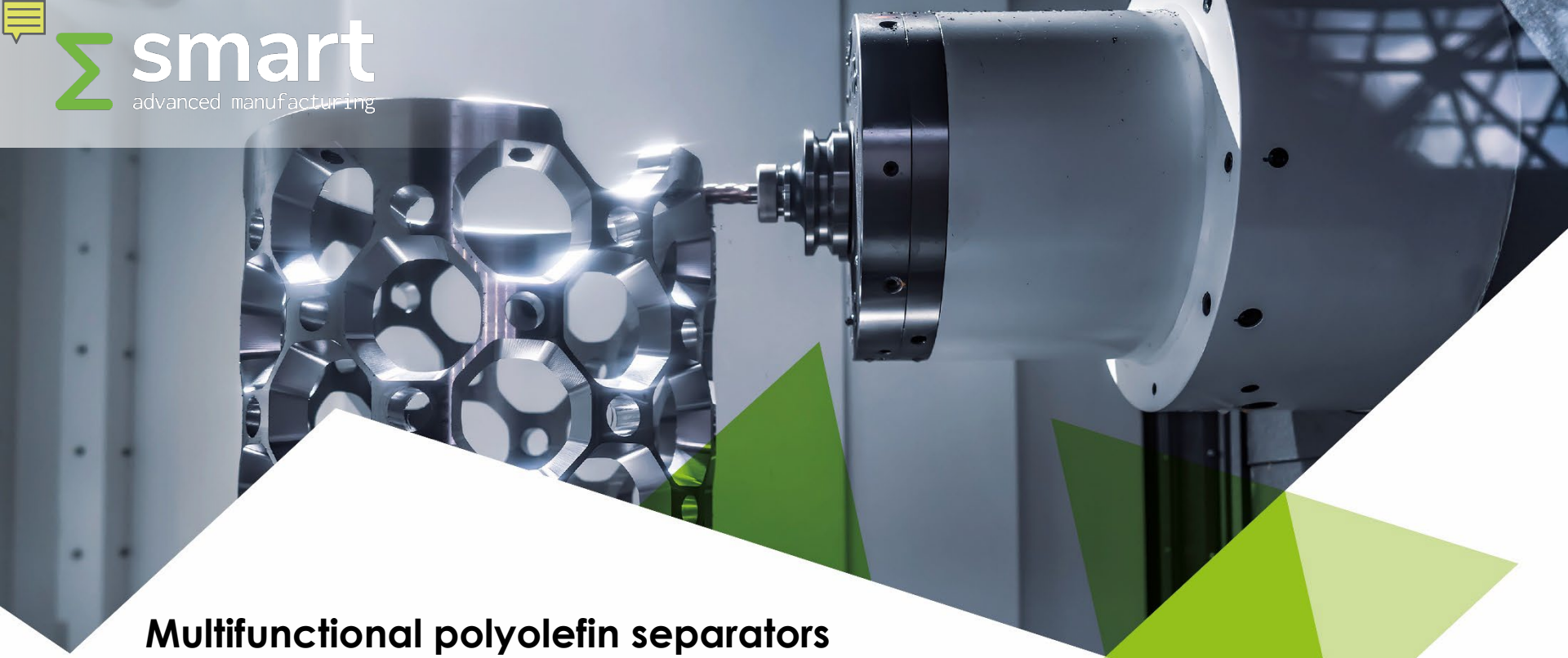

Multifunctional polyolefin separators for enhanced thermal stability and sustainability

MOIETY


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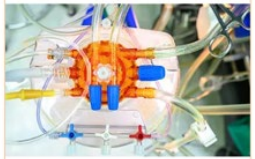
ORGANISATION PROFILE

GPC is an innovative polymer and product development company based in Galway's Technology Hub since 2017.

On-site services include R&D, material compounding, film and sheet extrusion, with multi- and barrier-layer capability, as well as production and testing.

GPC provides incisive, practical, and cost-effective solutions to enhance product functionality, safety, and sustainability for life science companies globally.

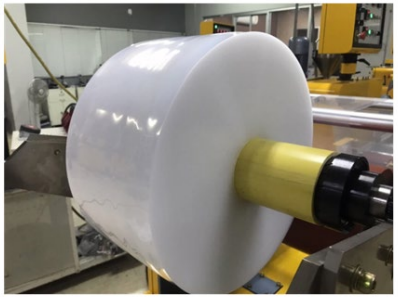
GPC Technological Capabilities



Polymer Materials

Product Development

Environment and Sustaina...

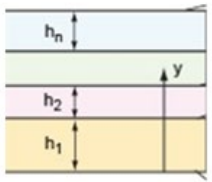


Compounding

Multilayer Co-extrusion

Permeability Testing

Mechanical Testing



PROPOSAL INTRODUCTION (I)

Vision:

To develop multifunctional polyolefin separators for Li-ion batteries that provide **enhanced permeability and shut down performance.**

The overall goal is to improve the safety, reliability, and lifespan of lithium-ion batteries.

Multifunctional and high-performance separators are of vital importance for battery safety and longevity. They control lithium-ion permeability from anode to cathode when the battery is discharging. Owing to their low cost, ease of manufacturing, and chemical and electrochemical stability the majority of separators are made from polyolefin materials. These materials include polyethylene (PE), polypropylene (PP) and PP/PE/PP multilayer films. Multilayer films comprised of alternating PP and PE in particular allow designers to achieve higher battery performance in terms of thermal stability, ion permeability and mechanical strength. However, **as the need for higher energy density batteries increases so too does the need to preserve separator integrity and safety.**

The specific capacity of lithium metal is 3860 mAh/g which is ten times higher than the specific capacity 370 mAh/g of graphite. Currently, use of lithium metal as an anode is considered unsafe because of the potential of dendrite deposits on the lithium electrode during charging-discharging of cell. Graphite is used to mitigate dendrite growth. Lithium metal anodes encourage the formation and growth of lithium dendrites at the metal surface lithium into the porous polymer separators. Dendrites can progress from the anode through the separator leading to eventual catastrophic shorting and destruction of the battery. There is an **urgent need to exploit the safe use of higher energy density lithium batteries through the development of smarter separation constructs that eliminate dendritic growth in lithium anode batteries.**

PROGRAMME

The project aims to develop a smart multilayer polymer separator that **permits faster charging-discharging of the battery cell whilst limiting the potential for lithium-ion dendrite growth.**

One part of the work will be directed at aimed at achieving **high permeability (= faster charging and discharging)** in the separator. This builds on a rational material selection methodology and related gas barrier modelling as used to explore the relationship between simple multilayer constructs and permeability.

Based on insights from these models, the permeability performance of multilayer materials was optimised by varying the composition of multilayer film in the through-thickness direction, both in terms of material type and film layer thickness. It was evident from this work that material permeability depends critically on both multilayer film structure and on material constituents.

Correlation between predicted and measured permeability values demonstrated the viability of this approach for multilayer separator development, and the ability to tailor separator properties for rapid charging/discharging.

A second major topic will explore the incorporation of smart polymer or composite layers that change structure in response to either, or both; an increase in localised columbic charge or heat. The mechanism involves the localised **volume expansion of a multilayer component that closes down ion permeability pathways through the porous separator under critical conditions**.

PROPOSAL INTRODUCTION (II)

Expected outcome:

The development of a smart multilayer polymer separator that permits faster charging-discharging of the battery cell whilst limiting the potential for lithium-ion dendrite growth.

Impacts:

- The construction of safe, higher energy density lithium-ion batteries
- Battery innovation could enable 30% of the required reductions in carbon emissions in the transport and power sectors, provide access to electricity to 600 million people who currently have no access, and create 10 million safe and sustainable jobs around the world [WEF, 2019]
- Global Li-ion battery chain, forecasted to grow by over 30 percent annually from 2022 to 2030, when it would reach a value of more than $400 billion [McKinley, 2022]

https://www3.weforum.org/docs/WEF_A_Vision_for_a_Sustainable_Battery_Value_Chain_in_2030_Report.pdf

https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/battery-2030-resilient-sustainable-and-circular

PARTNERS

Current

None confirmed at present. Discussions underway with GPC client base including battery manufacturer, academic and material supply partners.

Schedule:

The above programme is intended as a two-year product development project to be carried out by staff at Global Polymer Consulting (GPC) and consortium members, and provided with materials by GPC's supplier network as necessary for the work. A member of each company's staff would be appointed to the project with responsibility for maintaining contact between the collaborating partners.

Partner search:

Looking for partners in the manufacture of lithium batteries willing to explore the development of the next generation battery separator using advanced multilayer cast film extrusion and compounding technologies.

CONTACT INFO

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Dr. Mike Martyn (mike@globalpolymerconsulting.com)

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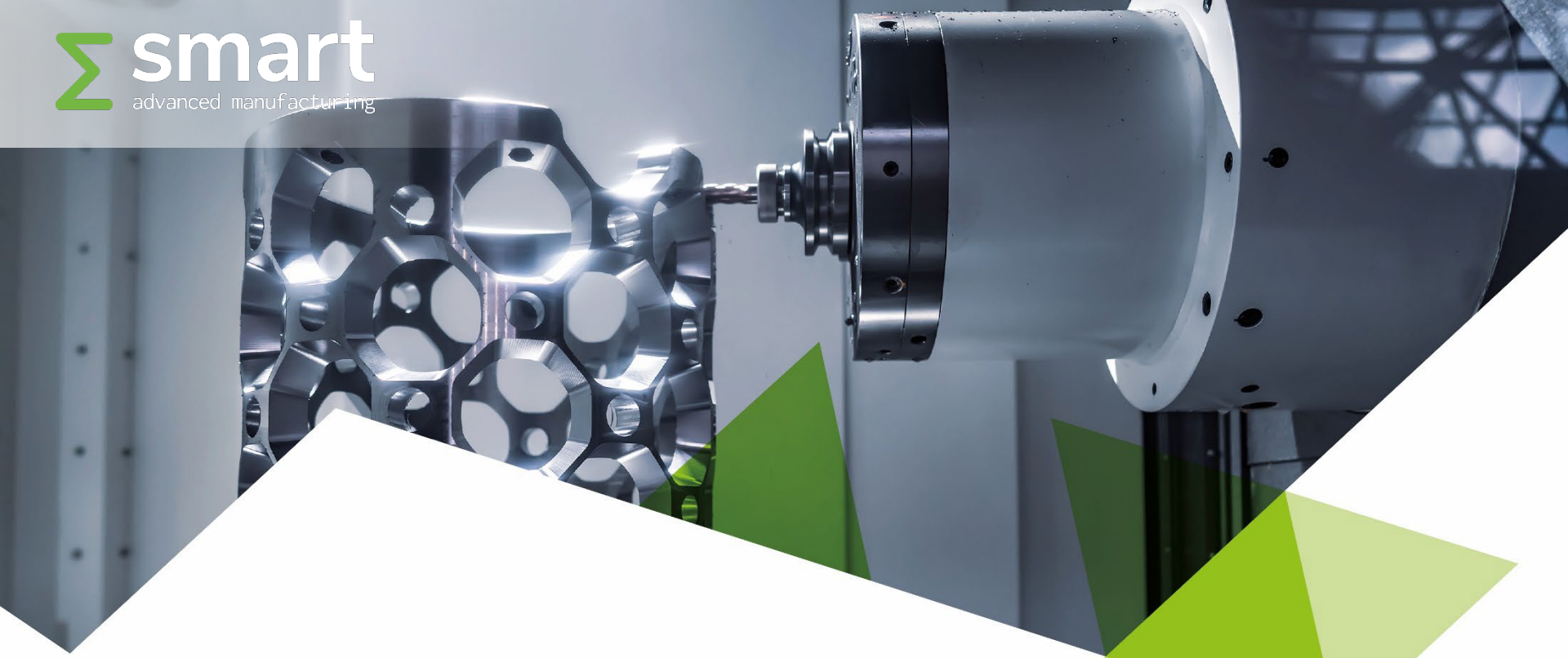

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