Ending Plastic Waste Symposium 2023

Plastic waste and its potential role in the future of green energy

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Our team is developing membranes to help separate out monomers and other useful depolymerisation products of plastic waste. In this work, we suggest that these constituents could be upcycled for green energy applications.

Membrane Technology

- Advanced recycling techniques allow for plastic waste to be broken down into its constituent parts – a mixture of monomers, oligomers, and other small hydrocarbons, which can be re-established into new polymers for a sustainable economy
- However, complexities arise with how to isolate the useful chemical components before they can be valorised
- That's where membranes can come in: highly selective and low energy means of separation

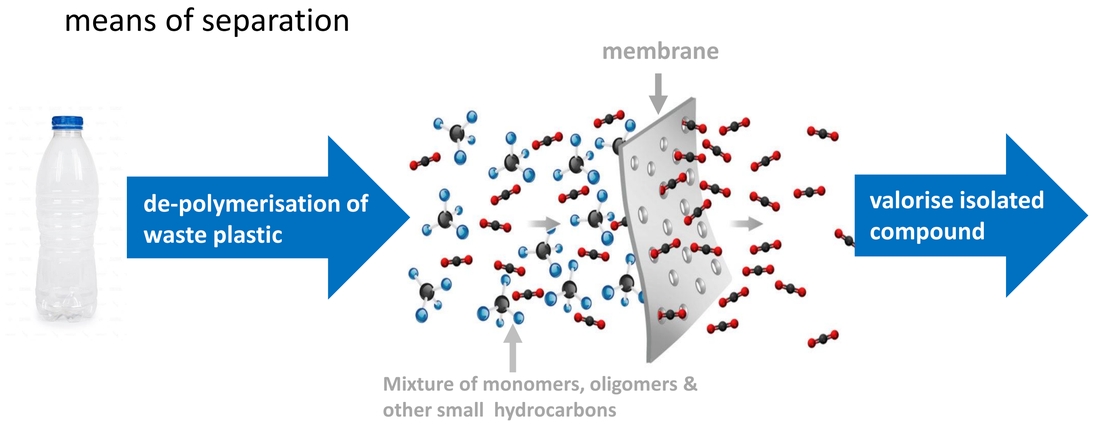


Figure 1: the role of membranes in plastic waste recycling[1]

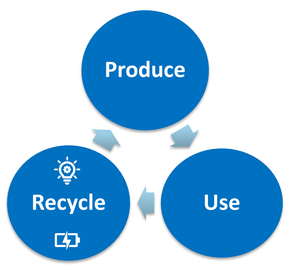
- Our team is working on developing mixed matrix membranes to help improve the feasibility of advanced plastic recycling
- Figure 2 is an example of a recently fabricated dual layer membrane for efficiency improvements in the glycolysis process of PET

Figure 2: PVA-1 wt.% AlFu-PTFE membrane for ethylene glycol/water separation to allow EG re-use

- Further membranes will be developed to help separate out waste plastic depolymerisation products, which can be recycled into new products for use across various industries

Enhancing the Circular Economy

- Plastic waste is perceived as a burden, but it has desirable properties and can be a valuable resource
- Many components in green energy technology are made from plastic, or its breakdown products
- Here presents the opportunity to use recycled materials in their manufacture to improve resource security for our green energy future
- This would convert waste plastic into products of greater value: the true definition of upcycling



Potential Upcycle #1: Liquid Organic Hydrogen Carriers (LOHCs)

- Plastic waste is commonly depolymerised into oils, which are then burnt as fuel - instead we could utilise these aromatics as LOHCs
- LOHCs are compounds that can be hydrogenated and employed to transport green hydrogen utilising existing oil pipelines
- They can then be dehydrogenated at the target destination and reused thereafter in a sustainable manner

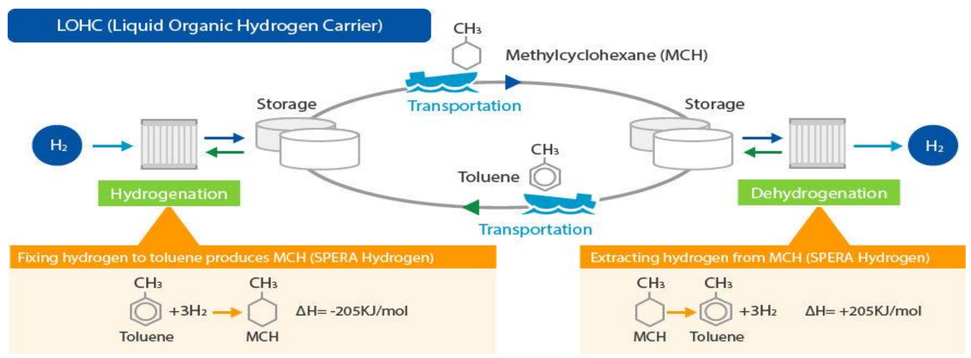


Figure 3: LOHC model (SPERA Hydrogen) commercially performed by Japanese company Chiyoda[2]

Potential Upcycle #2: Organic Redox Flow Batteries

- Organic redox flow batteries are promising candidates for low-cost, safe, and grid-scale energy storage
- The electrolyte carries charge, and contains organic redox active species[3,4]
- Could obtain these organics from plastic waste depolymerisation products

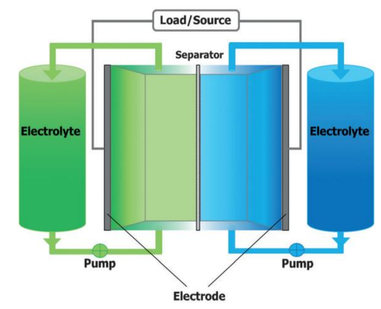


Figure 4: Redox flow battery schematic[3]

Potential Upcycle #3: Solar Panels

- Solar panels are comprised of up to 10% plastic
- Commonly, PET-based back sheets, ethylene vinyl acetate (EVA) encapsulants, and PET junction boxes[5]
- The opportunity arises to create solar panel components from the captured waste plastic monomers
- Coveme and Dupont Teijin Film have created 33% rPET back sheets[6]

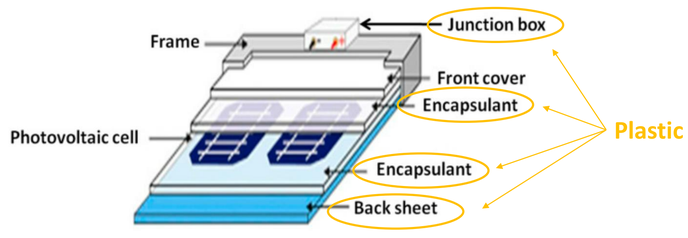


Figure 5: Typical solar panel, with plastic components highlighted[5]

FOR FURTHER INFORMATION
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