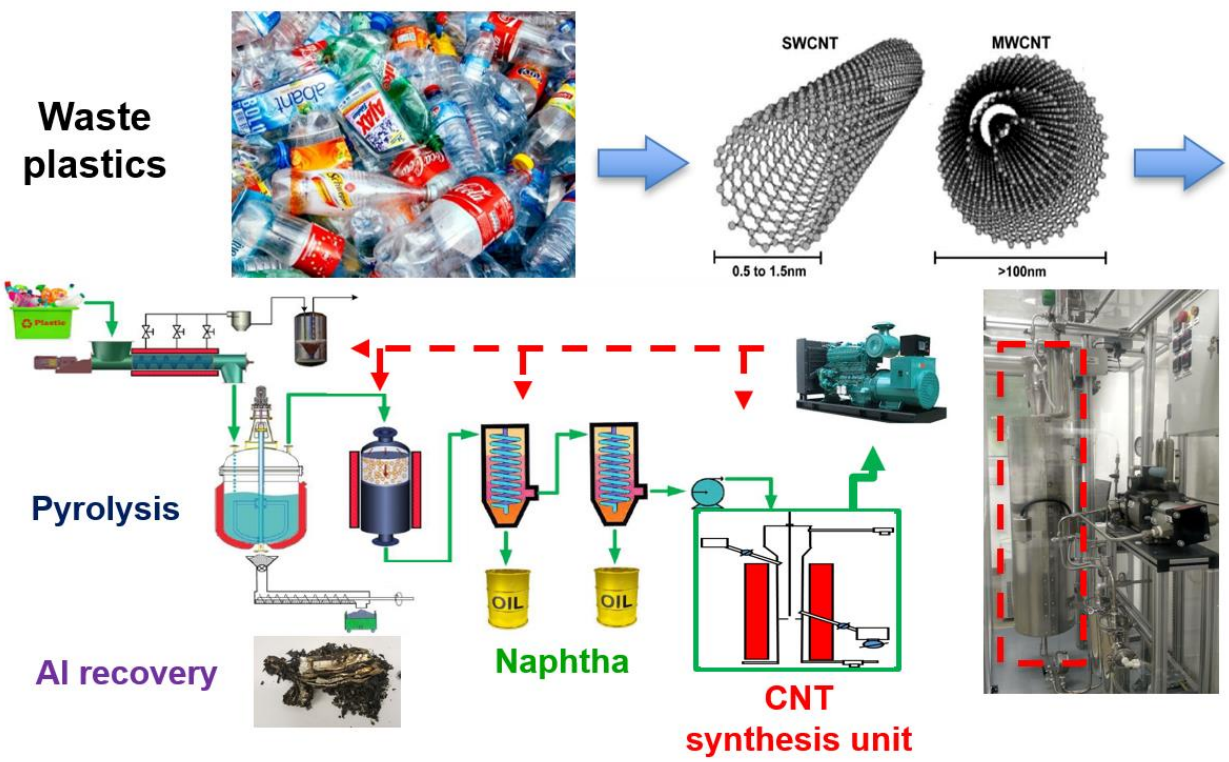
NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE | Nanyang Environment and Water Research Institute

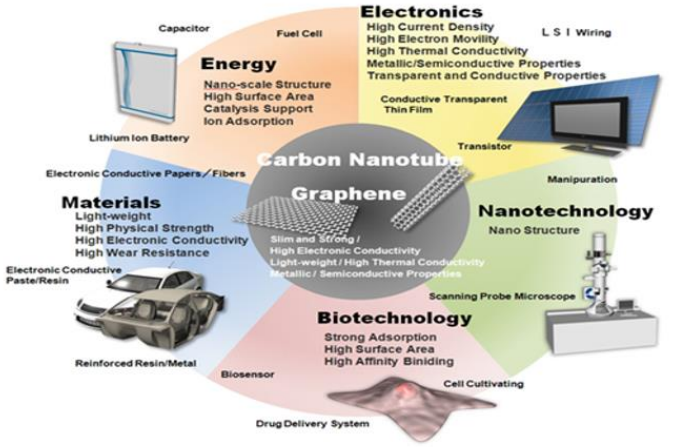
DEVELOPMENT OF SCALABLE PYROLYSIS-CHEMICAL VAPOR DEPOSITION TECHNOLOGY FOR CONVERSION OF CONTAMINATED & REJECTED PLASTICS INTO CARBON NANOTUBES & HYDROGEN

Abstract:

A significant fraction of plastic waste has substandard quality for mechanical and chemical recycling, even after sorting and cleaning. This project leverages the use of pyrolysis-chemical vapor deposition (CVD) technology for converting these plastic waste streams (specifically, contaminated and rejected plastics) into multi-walled carbon nanotubes (MWCNTs) and hydrogen. Pyrolysis-CVD technology has shown its flexibility in processing the mixed contaminated plastics in laboratory studies. The technology has the potential to reduce direct carbon emissions from plastic waste treatment by ~70% compared to incineration. MWCNTs from the process can find applications in existing and emerging markets, including polymer compounding, construction, coatings, and energy storage.

Hydrogen released as a by-product is a strategic energy source for decarbonization and an important input in the petrochemical and fertilizer industries. Some challenges, limiting implementation of the technology, will be addressed during the project, increasing the technology readiness level from 4 to 6. This will bring the technology closer to industrial application capable of diverting up to 20,000 tonnes/year of plastics from incineration. The innovation of the project lies in the development of an improved catalyst with lower cost and higher efficiency for processing contaminated and rejected plastics, a scaled-up system prototype for plastic waste conversion with increased throughput, and understanding the overall life cycle assessment of the process. The translation of research outcomes into commercial deployment will be facilitated through an intellectual property (IP) licensing model. The developed IPs will be made available for both non-exclusive and exclusive licensing opportunities, with a specific focus on engaging project industry partners and third-party entities interested in scaling up the technology. This innovative waste management approach anticipates a significant positive impact, contributing to sustainable practices and increasing waste recycling rates in Singapore and beyond.





Carbon nanotube synthesis:

- Integrated with plastics pyrolysis into naphtha.
- Accepts mixed, contaminate and rejected plastics.

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