Summary

Proposal Title: Process Intensified Modular Upcycling of Plastic Films to Monomers by Microwave Catalysis

West Virginia University Research Corporation

Principal Investigator: Yuxin Wang

Team Member: Covestro LLC, Malachite Technologies, Inc.

Objectives

The overall objective of the proposed project is to develop a plastic films upcycling technology that are economically favorable, lower greenhouse gas (GHG) emissions, and reduce the embodied energy of plastics. For example, compare to conversional ethane cracking process for ethylene producing, the proposed technology will achieve 55-66% energy saving and 50-63% GHG reduction, 57-76% post-use carbon management, and 69-75% cost saving.

Description of the project

The proposed project is based on microwave-specific effects on the catalytic upcycling of plastic films for the production of high-value monomers. The use of microwaves enables the depolymerization of plastic films both kinetically and energetically favorable at lower temperatures with high selectivity. The project will address catalyst and microwave catalytic reactor development, process optimization, engineering scalability, as well as economic and environmental benefits investigations.

Methods employed

Our approach integrates microwave reaction chemistry into catalytic material development with the goal to improve energy and capital efficiency for plastic films upcycling, as well as GHG emissions reduction. Particularly, the project will demonstrate the feasibility of using microwave energy for plastic films upcycling with high-value monomers (ethylene or BTX aromatics) production. The efficient catalyst and microwave catalytic upcycling system will be proposed. The continuous feeding microwave reactor (CFMR) system will be developed to validate the feasibility and scalability of the microwave catalytic upcycling technology. Meanwhile, the techno-economic-analysis (TEA) and life-cycle-analysis (LCA) models will be developed to evaluate the economic and environmental benefits of the proposed technology.

Potential impact

The proposed technology is focused on efficient upcycling of plastic films and produce cost-competitive ethylene and BTX as the secondary feedstocks, it is aligned with primary EERE goals. Successful completion of the proposed project will lead to a reduction of virgin polymer production, reduction of GHG emissions and retention of embodied energy and carbon in the value chain, pushing it towards practical implementations. The successful of proposed technology will increase recycling infrastructure investment and create a greater number of recycling jobs across the United States.