# Summary/Abstract

**Project Title: Integrated Chemolytic Delamination and Plasma Carbonization for the Upcycling of Single-Use Multi-layer Plastic Films**

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**The University of Massachusetts Lowell (UML)** in collaboration with **National Renewable Energy Laboratory (NREL)**, with **Dow** as the industrial advisor and **HP Indigo Labels & Packaging** as the film materials supplier, aims to develop an integrated process to upcycle single-use multi-layer waste plastic packaging films, particularly targeting films containing polyethylene terephthalate (PET), polyethylene (PE), ethylene vinyl alcohol (EVOH), aluminum (Al) foils, and $TiO_2$. The proposed technology begins with chemolytic delamination using green solvents (acetic acid, methyl acetate, ethanol, or their blends) to delaminate multi-layer films and to concurrently dissolve and convert PET into terephthalate acid (TPA) and ethylene glycol (EG) and Al foils into aluminum acetate. The undissolved portion of the waste films are subsequently cleaned by melt filtration for $TiO_2$ removal, followed by plasma carbonization powered by electricity (ideally from renewable sources, leading to near-zero $CO_2$ emissions) for producing carbon materials (carbon black, etc.) and hydrogen gas from PE and EVOH. The produced hydrogen can be used for industrial chemical synthesis processes or as a clean energy for powering the process. Unlike existing technologies that face challenges either to robustly handle heterogeneous film compositions or to recycle the waste films into high quality products, the proposed technology aims to ***upcycle multi-layer plastic packaging films into high-value chemicals (i.e., TPA and EG), carbon materials (e.g., carbon black), and hydrogen via a robust, environmentally benign, and scalable process*****.** Thanks for its mild process conditions and compact footprint, this technology is ideal for distributed operations, particularly near waste film sources, or for local manufacturing, promoting economic growth and resiliency of small or remote communities.