The First International Conference on Advanced Materials for Printed Electronics and Sensors
(ICAMPS2020), 10-11 September 2020
E-Conference, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand

# Trash to Treasures: Chemical Recycling of Polyesters for Use as Value-added Functional Materials

Pakorn Opaprakasit[a,*], Bunthoeun Nim[a], Mantana Opaprakasit[b], Atitsa Petchsuk[c]

[a] *School of Bio-chemical Engineering and Technology, Sirindhorn International Institute of Technology (SIIT), Thammasat University, Pathum Thani, Thailand 12121*
[b] *Department of Materials Science, Faculty of Science, Chulalongkorn University, Bangkok, Thailand, 10330*
[c] *National Metal and Materials Technology Center, 114 Thailand Science Park, Pathum Thani, Thailand 12120*

*Corresponding Author's E-mail: pakorn@siit.tu.ac.th

**Abstract**

Rapid increase in plastic consumption rate leads to many serious environmental problems. Although mechanical recycling of post-consumer plastics has been practiced, deterioration in properties of the resulting products limits their use to only low-value products. Chemical recycling of plastic wastes into their smaller-sized constituents is vitally important in converting these into starting materials for other value-added products, which can accelerate global transition towards the circular economy for sustainable development. In our research center, processes for effective chemical recycling of post-consumer polyester products, especially the most widely-used poly(ethylene terephthalate) (PET), polylactide (PLA), and polybutylene succinate (PBS), utilizing alcoholysis reaction have been developed. Microwave irradiation and suitable catalyst systems are employed, in comparison with conventional heating sources. Effects of chemical structures and number of hydroxyl functional groups of the alcohol reagents on the reaction efficiency, production yield, and structures of the resulting alcoholyzed products have been examined. Chemical structures of the products and insights into mechanisms of the reactions were investigated by gel-permeation chromatography (GPC), 2-dimensional nuclear magnetic resonance (2D-NMR), and Fourier transform infrared (FTIR) spectroscopy. Efficiency of the alcoholysis process, types of the alcohol reagents, and the process conditions have been successfully optimized to generate products with desired chemical structures and properties. Feasibility of scaling up the process has been assessed. These resulting products have high potential for use as starting materials for value-added products, such as, metal organic framework (MOF) materials, polyester-cured natural rubbers, aliphatic-aromatic copolyesters, degradable polyester-based adhesives, polyurethane products, and polymeric 3D- printing filaments.

***Keywords:*** *Chemical recycling, Polyesters, PET, PLA, Alcoholysis*