Thesis Title	Investigation of Local Raw Materials for the Production of Lithium-ion Battery Separators in Thailand
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ABSTRACT

This study investigates the influence of die exit temperature on the crystalline structure, morphology, and electrochemical performance of polypropylene (PP) separators fabricated via the dry stretching process. The objective was to optimize processing conditions and evaluate the feasibility of using both imported (Sinopec PPH-T03-S) and domestic (IRPC S1003) polypropylene resins for lithium-ion battery separator production.

Precursor films were extruded at die exit temperatures ranging from 215°C to 245°C with a die draw ratio (DDR) of 160, followed by cold and hot stretching to generate microporous structures. Polarized FTIR and 2D-WAXS analyses indicated that lower die exit temperatures enhanced crystalline orientation and promoted well-aligned lamellae. SEM observations showed that separators fabricated at 215°C exhibited elongated and interconnected pores, while higher temperatures resulted in distorted lamellae, non-uniform pores, and partial pore closure.

Electrochemical testing revealed that the separator produced at 215°C achieved the highest electrolyte uptake (109.4 ± 4.4%) and superior charge–discharge performance, delivering a specific discharge capacity of approximately 178 mAh/g with an efficiency of 98.5%. Separators prepared at 230°C and 245°C exhibited reduced ionic transport and lower capacity due to suppressed pore formation and partial pore collapse.

For the domestic IRPC S1003 resin, a similar temperature-dependent trend was observed. The separator fabricated at 215°C showed balanced pore morphology and competitive electrochemical performance, whereas higher die exit temperatures led to either limited ionic conductivity or structural instability.

The scalability of the optimized condition was further evaluated using a machine direction orientation (MDO) process. MDO-fabricated separators exhibited finer and more uniformly aligned pores, improved dimensional stability, and extended cycle life exceeding 50 cycles, with charge–discharge efficiencies approaching 99%.

Overall, a die exit temperature of 215 °C was identified as the optimal condition, and the results demonstrate that domestic polypropylene can be effectively utilized for scalable lithium-ion battery separator production through appropriate processing control.

Keywords: Lithium-ion Battery, Separator, Polypropylene, Dry Process, Die Exit Temperature, Scale-up