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Electrochemical characteristics of phase-separated polymer electrolyte based on PVdF-HFP and ethylene carbonate

PVdF-HFP와 에틸렌 카보네이트를 이용한 상 분리된 폴리머 전해질의 전기화학적 특성 연구

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Microporous PVdF-HFP (kynar 2801) films were prepared by casting homogeneous mixture of PVdF-HFP and solvents such as ethylene carbonate, dimethyl carbonate, and ethyl methyl carbonate for the use in lithium ion polymer batteries. Since casting solvents are selected from the solvents used in lithium ion batteries, the residual solvents does no harm to battery performance, and thus excessive drying is not required in this system. The resulting film is composed of PVdF-HFP and ethylene carbonate. The phase separation between PVdF-HFP and ethylene carbonate was developed throughout the evaporation step. The ethylene carbonate phase will be replaced with liquid electrolyte and act as a channel for ionic transport.

The morphology of the film was characterized by extracting residual ethylene carbonate with methanol. The pore in the film after extraction corresponds to the site where ethylene carbonate is placed. With increasing ethylene carbonate content in the casting solvent, pore size in the film was increased, and there found an abrupt change of pore size and porosity at about 60% ethylene carbonate based on total weight of PVdF-HFP and ethylene carbonate. It seems that most of EC seem to exist in PVdF-HFP phase below 50-60% of ethylene carbonate, and the ethylene carbonate phase is well developed above 50-60% of ethylene carbonate. Ionic conductivity of the film soaked in liquid electrolyte was also abruptly increased at 60% of EC content from order of 10^{-4} to 10^{-3} S/cm, which is in good agreement with the change of film morphology. Graphite|polymer electrolyte|LiCoO2 cells based on this microporous PVdF-HFP polymer film showed stable charge-discharge characteristics even at 1C rate and good rate capability.