Interfacial Adhesion Property between Separator and Ceramic Coating Layer using SAICAS

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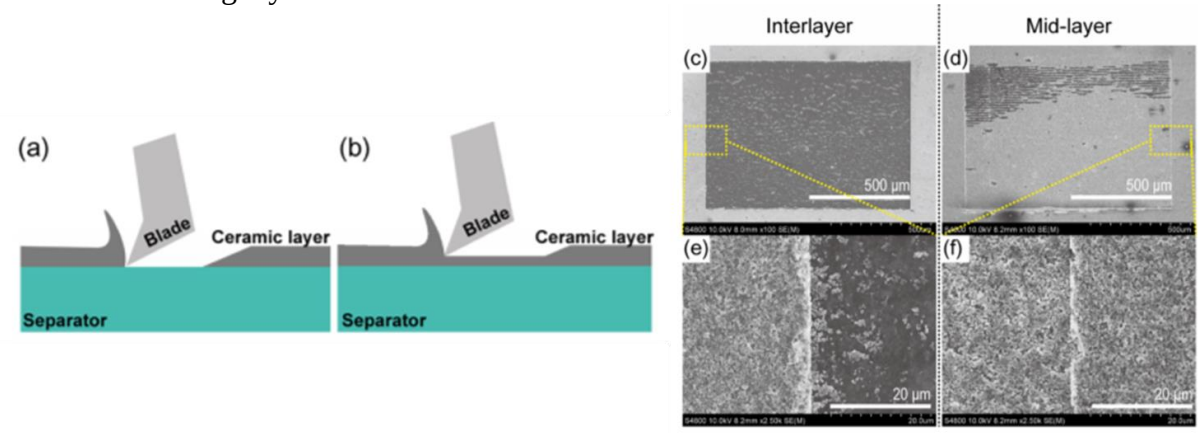
Ceramic-coated separators are essential components especially for large-format lithium-ion batteries (LIBs) to ensure their safety under abnormal condition. However, additional ceramic coating layer can degrade performance of LIBs due to increased resistance. That is why the thickness of ceramic coating layer should be as thin as possible and the polymeric binder content should be minimized. But, these approaches can lead to delamination and fracture of ceramic coating layer after high temperature storage or longer use. Regardless of the importance of maintaining the interfacial adhesion properties between bare polyolefin separators and ceramic coating layers, unfortunately, there is a lack of reports to investigate this. We have announced a method to improve the adhesion strength of ceramic coating layer by replacing the conventional polymeric binders with highly adhesive co-polyimides [1]. In addition, surface and interface cutting analysis system (SAICAS) has been applied to analyze the adhesive properties of ceramic coated separators [2, 3].

In this work, we systematically investigated the effects of polymeric binders and ceramic particles on the adhesion properties of ceramic coating layer. First, a variety of ceramic coating layer will be placed on the polyethylene separator by changing 1) the binder types and contents, 2) ceramic types and sizes, and 3) fabrication methods. Then, the adhesion properties are deliberately measured and analyzed after electrolyte impregnation at various temperatures using SAICAS. Finally, we want to build a correlation map to predict the adhesion properties of ceramic coating layers.



Schematics of the SAICAS measurements for (a) F_{inter} and (b) F_{min}. SEM images of the CCSs after measuring (c, e) F_{inter} and (d, f) F_{min} using a SAICAS

References:

[1] Y. Lee, H. Lee, T. Lee, M-H. Ryou, and Y. M. Lee, J. Power Sources. 294 (2015) 537–544.
[2] H. Jeon, J. Choi, M-H. Ryou, and Y. M. Lee, ACS OMEGA, 2 (2017) 2159-2164.
[3] H. Lee, H. Jeon, S. Gong, M-H. Ryou, and Y. M. Lee, Applied Suface Sci., 427 (2018) 139-146.