Thin ceramic layer-coated separators for lithium-ion batteries by RF sputtering

Taejoo Lee[1], Dong Jin Lee[2], Yunju Lee[1] and Yong Min Lee[1,*]

[1]Department of Chemical and Biological Engineering, Hanbat National Univ., 125 Dongseo-daero, Yuseong-gu, Daejeon, 305-719, Korea
[2]Department of Chemical and Biomolecular Engineering, Korea Advanced Institute of Science and Technology (KAIST), 291 Daehak-ro, Yuseong-gu, Daejeon 305-701, Korea

* yongmin.lee@hanbat.ac.kr, +82-42-821-1549

As lithium-ion batteries (LIBs) started to be used as a power source for hybrid electric vehicles, the safety issue became more important. Among various components and design factors in LIBs, polyolefin-based microporous separators have been in the spotlight due to their insufficient thermal stability over 150^{o}C. Without those thermal properties, LIBs with high capacity cannot be free from thermal accidents originated from internal short-circuit between fully charged cathode and anode. As a result, the separator for large-format applications must contain highly heat-resistive components such as ceramic-coated layer. However, the additional layer can make the separator price be more expensive while the overall battery price should be reduced remarkably in the near future. Therefore, there are a few previous reports to reduce coating cost by using other economic processes such as atomic layer deposition and chemical vapor deposition [1, 2]. However, both methods have not been commercialized probably owing to long manufacturing time or low availability for continuous process.

In this work, thin ceramic coating layer is prepared upon PE separators by RF sputtering method with Al_2O_3 and SiO_2 targets. The coating layer and morphology are controlled by coating time and applied power values. With a submicron ceramic coating layer, the prepared ceramic coated separators (CCSs) can have sufficient thermal properties comparable to conventional CCSs. In addition, CCSs are electrochemically evaluated by ion conductivity, contact angle and uptake amount for wettability, rate capability, and long-term cycle life.

References

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