Strength Enhancement of Electrode/Current Collector Interfacial Adhesion

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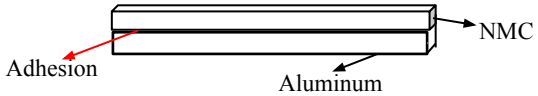
MOTIVATION



Interfacial adhesion between electrode and current collector is important for structural stability of battery under mechanical load. Also, the volume change issue of electrode particles during cycling also require strong adhesion from electrode binders to maintain the structure PAN binder has higher adhesion strength than PVDF binder, but it will form a covering on the electrode surface due to its high film forming property and the slow evaporation of solvent in electrode slurry during drying process of electrodes, which will lead to poor electrolyte permeation and capacity loss.
Therefore, finding suitable recipes and baking process to eliminate the covering of PAN binder is significant in battery performance.

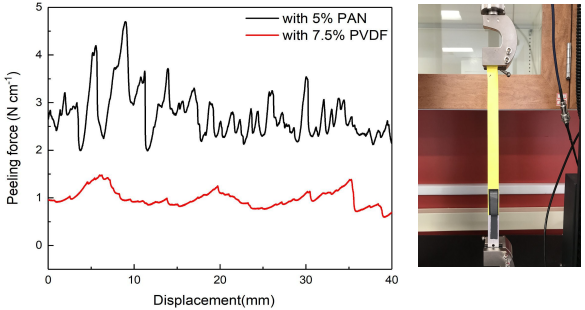


Figure 1.Peeling Off results of NMC electrodes with 5% PAN and 7.5% PVDF as binders, with a photo of the peeling-off test setup.

METHODS & RESULTS

Conventional 7.5% ratio of binders and 70℃ baking process is not suitable for PAN binder due to the covering issue, thus different recipes and drying processes are investigated to realize PAN binder without the covering issue. Finally, electrode with 5% PAN which is baked at 110 ℃ shows no covering issue with satisfying adhesion and cycling performance.

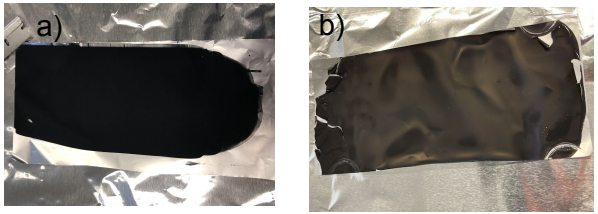


Figure 2. Image of NMC electrodes with (a) 5% PAN dried at 110 ℃, and (b)7.5% PAN baked at 70 ℃ which has a shiny surface, respectively.

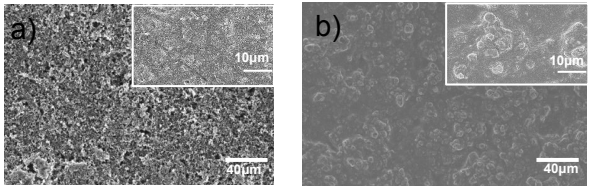


Figure 3. Surface morphologies of NMC electrodes with different ratios of PAN under different baking processes. (a) NMC electrode with 5% PAN baked at 110 ℃, (b) NMC electrode with 7.5% PAN baked at 70 ℃.

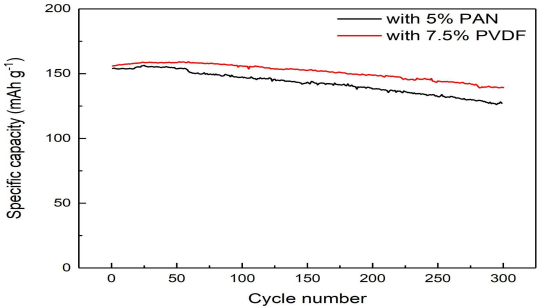


Figure 4. Electrochemical performance of Li|NMC coin cells with 5% PAN and 7.5% PVDF as binders for NMC, respectively.

CONCLUSION

By modification in recipes and electrode preparation process, 5% PAN has 3 times stronger interfacial adhesion than 7.5% PVDF without trade-off battery performance.

FUTURE STUDIES

Application of PAN in industry and structural battery.

ACKNOWLEDGEMENTS/REFERENCE

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