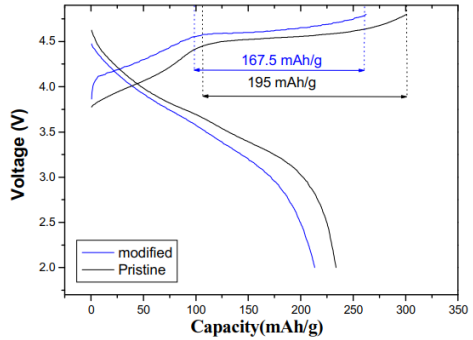
高容量正極材料與高穩定性電解液儲能元件技術開發

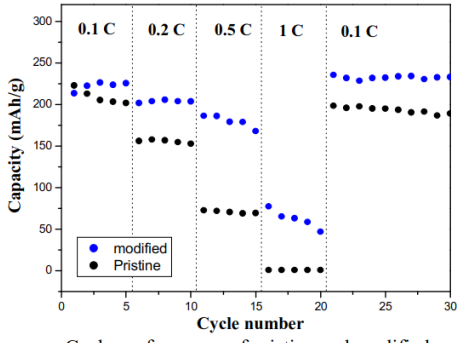
執行單位	國立臺南大學綠色能源科技學系	計畫主持人	張家欽教授

- 本計畫開發高容量、高電壓正極材料與高穩定性電解液之儲能元件技術。鋰離子電池是具高克電容量、高能量密度之高價值儲能元件，能廣泛應用在 3C、通訊、智慧電網與電動車輛。

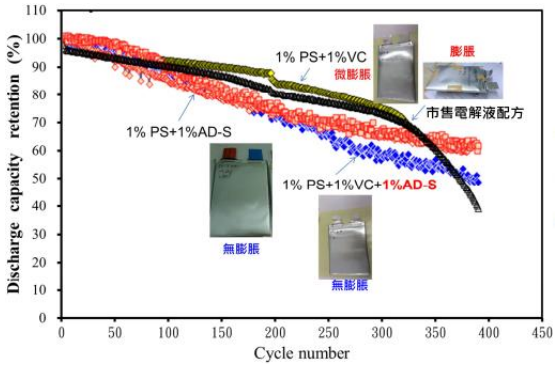
證書號：I518331
專利名稱：導電探針及其絕緣溝槽製造方法
本發明揭露一種導電探針及其絕緣溝槽製造方法。導電探針係應用於原子力顯微術，并包括一基座、複數支持元件、複數探針頭以及一導電層。基座具有一表面及複數突起部，該等突起部間隔配置於表面上，兩相鄰突起部之間具有一絕緣溝槽。

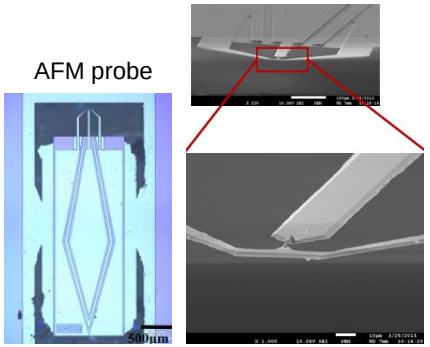


Charge – discharge curves of pristine and modified $0.5Li_2MnO_3$•1-$0.5LiNi_{1/3}Mn_{1/3}Co_{1/3}O_2$



Cycle performance of pristine and modified $0.5Li_2MnO_3$•1-$0.5LiNi_{1/3}Mn_{1/3}Co_{1/3}O_2$





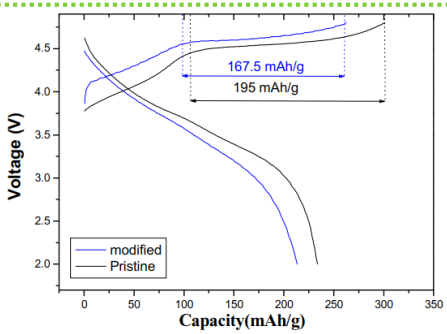
- 本計畫在材料開發方面結合第一原理計算之基礎理論計算與材料合成技術並進行結構分析與鑑定，搭配表面碳膜修飾以降低高電壓複合層狀正極材料與電解液反應之特性進而提高正極材料之穩定性，再與電解液特性研究第一原理計算，耐高電壓、耐燃電解液及添加劑之驗證配合材料表面分析技術及產氣成分分析，對鋰離子電池界面微區性質與SEI膜的生成機制進行探討。
- 合成複合層狀正極材料$0.5Li_2MnO_3 \cdot 0.5LiNi_{1/3}Mn_{1/3}Co_{1/3}O_2$放電電容量可高達250 mAh/g。以還原處理進行富鋰正極材料粉體表面改質，改質之富鋰正極材料充放電30圈後電容量仍維持在235 mAh/g。
- 開發耐高電壓電解液及添加劑配方含1% PS+1% AD-S，在18650全電池充電至4.35V及R2032半電池充電至4.5V兩種測試條件中，電容量循環壽命穩定性皆優於市售電解液配方。於軟包電池60℃環境充電至4.2V循環壽命測試，顯著改善產氣問題。
- 建立開放式鋰離子電池阻抗量測系統，利用鎢鋼針搭配三軸探針座進行雙極式薄膜阻抗分析技術量測鋰離子電池界面，藉此建立薄膜電池材料之等效電路。
- 建立低壓CVD鍍碳系統並成功地在負極材料表面成長鏈狀奈米碳球，可以增進負極活性材間的電子傳遞路徑並增加儲鋰的能力。

High capacity cathode materials and High stability electrolyte for energy storage devices

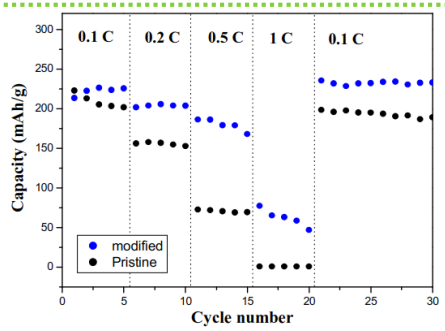
Execution Unit	Department of Greenergy, National University of Tainan
Project Director	Professor Chia-Chin Chang

- This project aims to develop high capacity cathode materials and high stability electrolyte for lithium-ion batteries. Lithium-ion batteries have attracted significant attention for applications in portable electronic devices, electric vehicles, and bulk electricity storage at power stations.

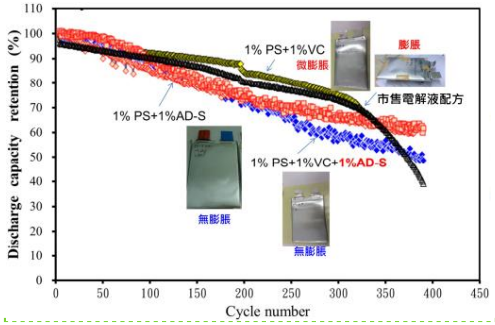
I518331：Conductive Probe and Insulating Trenches Manufacturing Method Thereof
The invention discloses a conductive probe and insulating trenches manufacturing method thereof. The conductive probe is applied in atomic force microscopy (AFM) and includes a base, a plurality of support elements, a plurality of tips and a conductive layer.

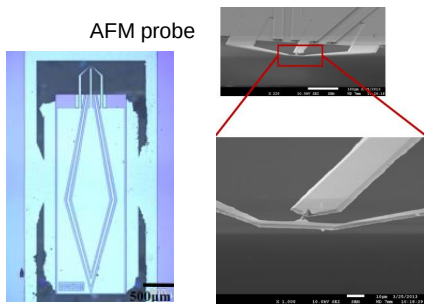


Charge – discharge curves of pristine and modified $0.5Li_2MnO_3$•1-$0.5LiNi_{1/3}Mn_{1/3}Co_{1/3}O_2$



Cycle performance of pristine and modified $0.5Li_2MnO_3$•1-$0.5LiNi_{1/3}Mn_{1/3}Co_{1/3}O_2$





- Discharge capacity of $0.5Li_2MnO_3$-$0.5LiNi_{1/3}Mn_{1/3}Co_{1/3}O_2$ of the layered composite cathode material was up to 250 mAh/g. Reduction process was used to modify the surface of lithium-rich cathode materials. The capacity of the modified cathode materials remained at 235 mAh/g after 30 charge-discharge.
- The cycling stability of our developed high voltage electrolyte with additive containing 1% PS + 1% AD-S is excellent than that of commercial electrolytes under two testing conditions (18650-battery charge to 4.35V and R2032 half-cell charge to 4.5 V). For soft pack battery charged to 4.2 V at 60^{o}C, the gas production problem during the charge-discharge cycle was also improved.
- An open lithium-ion battery impedance measurement system was established. A tungsten needle probe with a triaxle seat bipolar film was used in impedance analysis system and detected the impedance of the interface of lithium-ion battery thereby establishing an equivalent circuit of the thin film battery materials.
- A low pressure CVD carbon deposition system was established and successfully used for the grown of nanoscale carbon ball chains on the surface of the anode materials. The nano carbon balls can enhance the electron transfer path between the anode active materials and increase the capability.