2019「中技社科技獎學金」

2019 CTCI Foundation Science and Technology Scholarship

研究獎學金

Research Scholarship

高容量鋰電池矽基負極材料

High capacity silicon anode materials for lithium ion battery

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研究重點

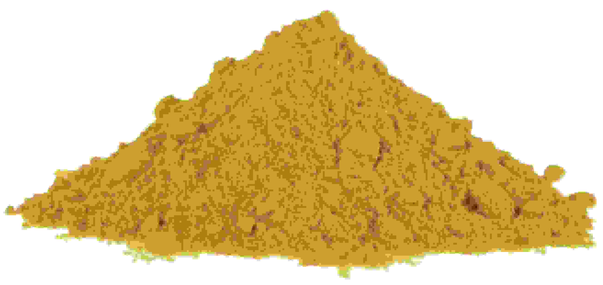
Lithium-ion battery (LIB) is one of the dominant power sources for electric vehicles, medical devices, and personal electronics because of long cycle life, high energy density, and light weight. However, to meet the higher demand on energy consumption of the high performance electric vehicles, electronics and medical devices in the future, extensive research has been taken in search of new anode materials of higher capacity while reaching low cost and long term stability. Silicon anode are known for their highest specific capacity. The theoretical specific capacity of silicon is 10 times higher than graphite. The main challenge for the silicon anode is it large volume change (up to 300%) during lithiation and delithiation, which result in pulverization and isolation of active material, leading to bad cycling performance.

To minimize the volume change effect in silicon anode materials, it is very effective to design the silicon anode as nanostructure materials. These nano-sized strategy has increased the cycle life of silicon anodes by up to few hundred cycles with very high Coulumbic efficency. On the other hand, pure silicon is infamous for its low conductivity, and thus silicon anode in high c-rate condition exhibit bad performance.

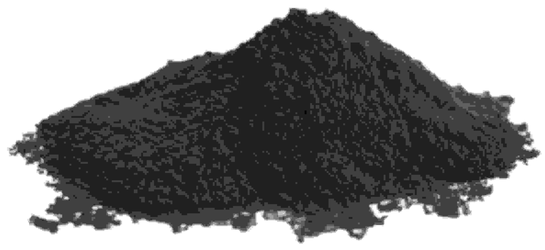
The research is focused on nano silicon/NUNCD composite anode with stable cycle life. We expect the silicon-based battery's performance will enhance by coating the nitrogen-incorporated ultrananocrystalline diamond (NUNCD) film on the surface of nano silicon particles. By coating these rigidity films, we not only overcome the volume change issues without pulverization of silicon particles, but also enhance the electrical conductivity of silicon.

研究成果

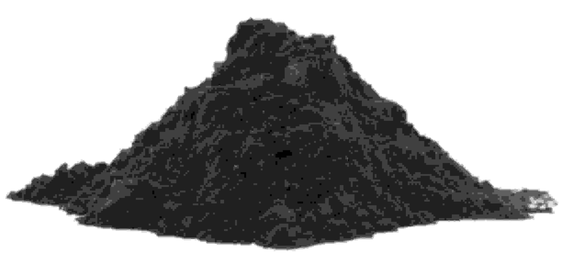
High Quality Nano Silicon

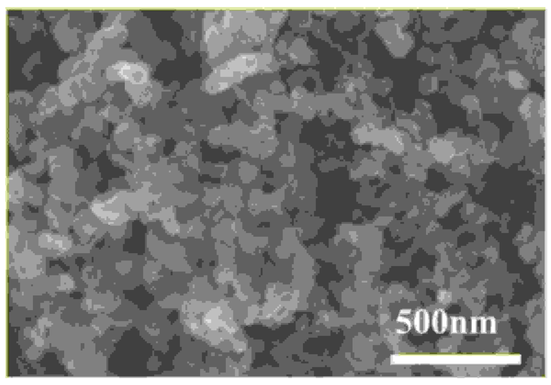


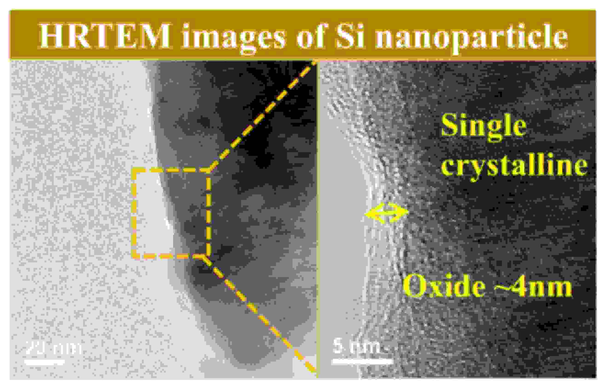
Silicon based anode materials

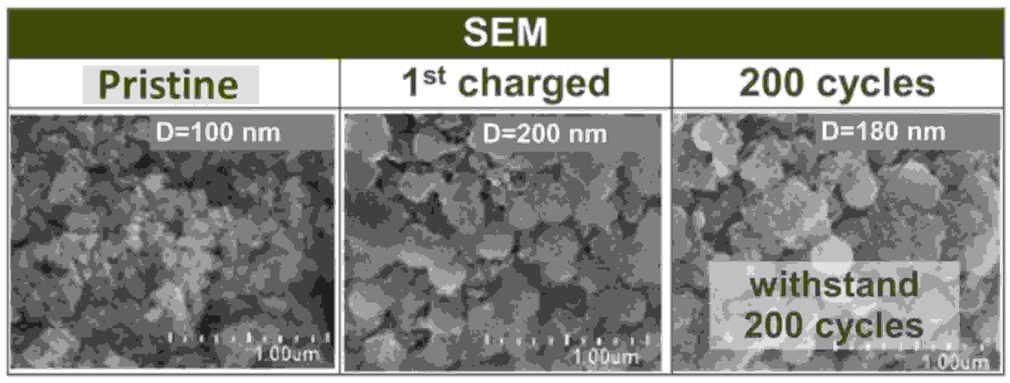


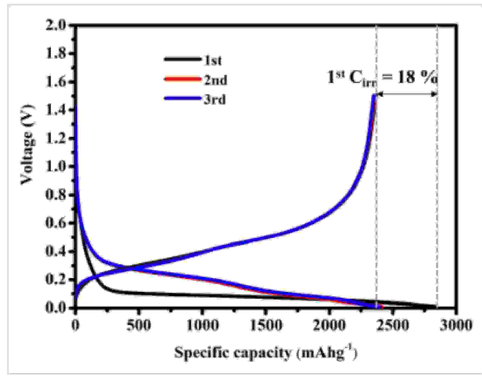
Silicon graphite composites anode materials

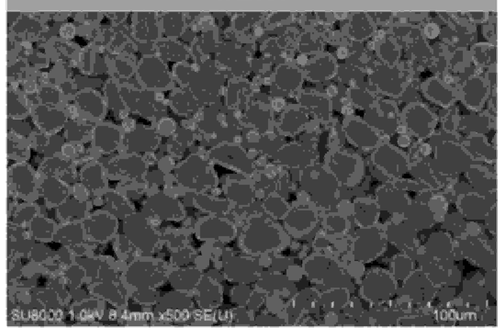


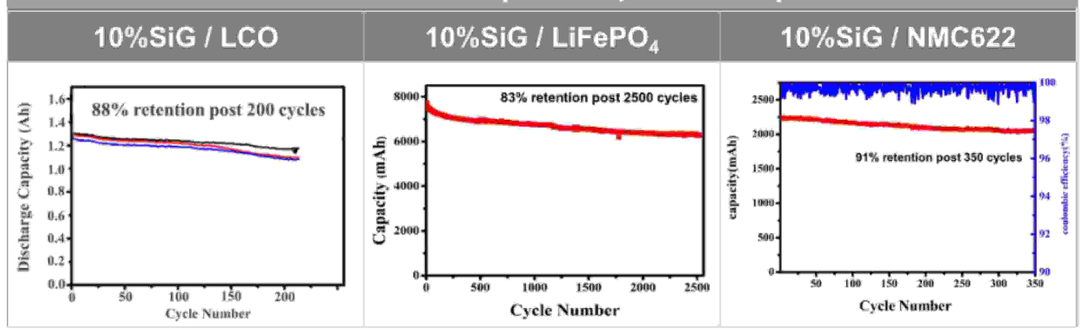












研究生活與心得

在成大的博士生涯裡，學校不僅給予我學識上的提升、研究精神的建立、敢於挑戰的勇氣，在美國國家實驗室研究學習的期間，讓我深刻體會到，科學與科技研究最終是為了提升人類福祉，我開始思索如何應用研究成果，再次回到充滿創業氛圍的成大校園，「成大國際產學聯盟」提供了海外市場拓展、國際資金媒合與完整的創業諮詢資源，從此我的博士班生活不在只是單純的研究生活，還有機會將研究成果轉換成創業項目。

非常感謝中技社以及評審委員給予的肯定，藉此機會要特別感謝成功大學材料系劉全璞教授、電機系曾永華院長、 UT Dallas Prof. ORLANDO AUCIELLO、台南大學綠能系張家欽院長以及實驗室的所有夥伴，沒有你們的協助與相伴，我無法單獨完成這份研究成果，這份榮譽是屬於曾經幫助過我的每個人。

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