CAMT Seminar

"Nanoparticle scaffolds for multilayered Si-based Li-ion battery anodes"

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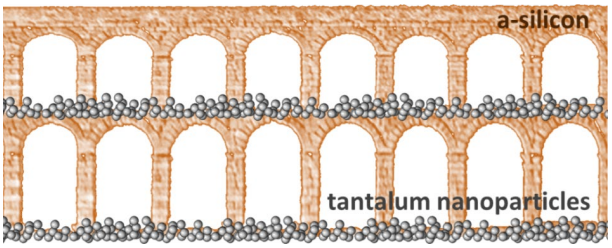
Date: 25 November, 2021 (Thursday) 14:00-15:00
Location: Main Conference Room (1st floor), Bldg. A12
Center for Atomic and Molecular Technologies (CAMT)
& Online (for the link, please contact the host)
(A12 棟 1 階会議室)

Abstract



As mentioned in the Nobel Prize in Chemistry 2019 press release: "*Lithium-ion batteries have revolutionised our lives… They have laid the foundation of a wireless, fossil fuel-free society, and are of the greatest benefit to humankind*." With this in mind, we (i) identified an optimised building block for our previously reported multi-layered Si-based Li-ion battery anodes [1], (ii) built it with a cheap, one-pot, green, and scalable cluster beam deposition method, and (iii) elucidated with large-scale atomistic computer simulations the underlying physical mechanism leading to its superior mechanical and electrochemical performance.

The *Nano-Vault* is a novel sculptured-thin-film nanostructure synthesised with the help of nanoparticles grown and deposited in the gas phase [2]. The name alludes to the civil engineering definition of a multi-arch structure sustained on columns, characterised by its high elastic modulus. As a result, Si anodes in Li-ion batteries with vaulted structures simultaneously show high mechanical stability and low lithium consumption during formation of solid electrolyte interface, addressing the two main challenges for Si anode commercialisation. This optimal electrochemical performance is associated with a distinct transition in mechanical behaviour at the exact moment when individual Si columns merge to form closed arches (but not beyond that point, with further growth of amorphous Si film on top).

The introduction of nano-vault and arch action brings many new possibilities in the design of new materials for batteries, but also, potentially, for other applications in which the surface is under variable and strong stress action.

References

1. M. Haro, V. Singh, S. Steinhauer, E. Toulkeridou, P. Grammatikopoulos, M. Sowwan, *Adv Sci* **4** (2017)1700180 (10pp)
2. M. Haro, P. Kumar, J. Zhao, P. Koutsogiannis, A.J. Porkovich, Z. Ziadi, T. Bouloumis, V. Singh, E.J. Juarez-Perez, E. Toulkeridou, K. Nordlund, F. Djurabekova, M. Sowwan, P. Grammatikopoulos, *Commun Mater* **2** (2021) 16 (10pp)

(Host: Satoshi Hamaguchi Ext:7913)