

Topic:

Improving Cycle Stability of Silicon Anode for Lithium-ion Battery Applications

Speaker:

Dr Denis Y. W. Yu, Associate Professor, City University of Hong Kong

Date: 26 July 2016

Time: 11.00am – 12.30pm

Venue: Room Y305

Abstract:

Silicon has been widely studied as a next-generation anode material for Li-ion batteries, as it has a high gravimetric capacity of up to 4000 mAh g⁻¹ and a low average discharge voltage of about 0.4V versus Li/Li⁺. The biggest challenge is to maintain reversibility of the electrode despite the large volume expansion of the alloy reaction. The theoretical volume expansion of Si/Li alloying is 311%, but the amount of electrode expansion depends highly on electrode composition and packing density. In the first part of the talk, we will introduce to use of electrochemical dilatometry to monitor the thickness change of Si electrodes in real-time during charge and discharge. We developed a model to explain the non-linear behavior of the electrode expansion and contraction with the amount of lithium. We are able to identify that binder breakdown as one of the causes of capacity degradation and show that better reversibility in thickness change can be achieved by using a binder with higher modulus such as polyimide. In the second part, we will discuss the effect of particle size on the stability of the electrodes. With optimized particle size, binder, electrode composition and electrolyte formulation, cycle performance can be improved.

Biography:

Dr Denis Y. W. Yu is an Assistant Professor at the School of Energy and Environment at City University of Hong Kong where he leads the Battery and Energy Storage Technologies Laboratory. He received his PhD in Applied Physics from the School of Engineering and Applied Sciences at Harvard University in 2003. He then worked as an engineer at SANYO Electric Co. Ltd. in Japan for 8 years, developing cathode and anode materials for Li-ion batteries. Afterwards, he led the battery activities at the Energy Research Institute at Nanyang Technological University and TUM CREATE Centre for Electromobility in Singapore as a senior scientist for two years before joining City University of Hong Kong in 2013. His expertise is on understanding fundamental reaction mechanisms in battery materials and electrodes, focusing on the effect of surface chemistry and structure on electrochemical performance, long-term stability and safety of the materials.