



Department of Materials Science and Engineering Ph.D. Candidacy Exam

11:00 AM, Bossone 302 (ECE Conference Room)

August 18<sup>th</sup>, 2011

## **Silicon Anodes in Li-ion Batteries**

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Batteries in general, and Li-ion batteries in particular are of special interest and importance in today's world, especially for transportation. The high energy density, which characterizes Li-ion batteries, has rendered them one of the top candidates. Silicon has a theoretical capacity of  $4200 \text{ mAhg}^{-1}$  which is more than 10 times the capacity of graphite that is commercially used nowadays. Despite its high theoretical capacity, silicon to date did not find its way to the marketplace, due to its high irreversible capacity and short life-time. The latter are believed to be due to the large volume variations (>300%) that occur during lithiation and de-lithiation, which in turn results in cracking of the anodes and lose of the electronic contact between the anodes and the current collectors. The Si lithiation mechanisms will be described for crystalline micro and nano-sized Si in addition to amorphous silicon. Also the silicon failure modes in Li-ion batteries will be discussed. Finally, some strategies for engineering Si anodes with overall better performance will be discussed.