Licentiate Seminar

Large-scale nanographite exfoliation for metal-free supercapacitors

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Abstract

The number of applications based on graphene, few-layer graphene, and nanographite is rapidly increasing. A large-scale process for production of these materials is critically needed to achieve cost-effective commercial products, such as supercapacitors. Supercapacitors are fast energy storage devices with high pulse efficiency and superior cyclability with applications ranging from consumer electronics to vehicles and grid.

In this thesis I present a novel process to mechanically exfoliate industrial quantities of nanographite from graphite in an aqueous environment with low energy consumption and at controlled shear conditions. In addition, I demonstrate a novel aqueous low-cost and metal-free supercapacitor concept where I used graphite foil as the current collector and a mix of graphene, nanographite, simple water purification carbons, and nanofibrillated cellulose as electrodes. The electrodes were coated directly on the graphite foil using casting frames and the supercapacitors were assembled in a pouch cell design. The supercapacitors possessed about half the specific capacitance in comparison to commercial units but the material cost reduction was more than 90 %, demonstrating an environmentally friendly low-cost alternative to conventional supercapacitors.

External Reviewer: Professor Aleksandar Matic

When: August 31st 2016, 10:15

Where: Mid Sweden University campus Sundsvall O102

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