

## Synthesis of Amorphous Iron Oxide Nanosheets and Study on Its Lithium Storage Mechanism

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Transition metal oxides have been intensively investigated as anodes for lithium ion batteries due to their higher energy densities, safety and durable cyclability. [1] Among all the transition metal oxides, iron oxides are inexpensive, environmental-friendly and have relative higher theoretical capacities (1006 mAh g<sup>-1</sup> for Fe<sub>2</sub>O<sub>3</sub>). [2] Fe<sub>2</sub>O<sub>3</sub> has conversion reactions with Li to yield Fe and Li<sub>2</sub>O, and this conversion reaction is only efficient and reversible in nanoscale particles. [3] Besides, the volume variation resulted from concomitant Li intake and removal may cause particle cracking, which further leads to capacity fading. Therefore, proper nanostructuring is required to promote the thermodynamics and kinetics of lithium storage reactions and enhance the capacity retention.

Besides of nanostructuring, other approaches, such as forming loosely porous network and compositing with a buffering media (e.g. graphene), have also been investigated to enhance the stress accommodation and strain tolerance. Amorphization is another effective approach to enhance the stress tolerance and in turn improve the cycling stability. In quest for the influence of crystallinity on the lithium storage performance, different amorphous anode materials has been synthesized and characterized electrochemically. The amorphous TiO<sub>2</sub> nanotubes possess higher capacities and better capacity retention than that of anatase-phased crystalline TiO<sub>2</sub> with identical composition and morphology; [4] Ku and co-workers demonstrate different lithium storage of amorphous Molybdenum Dioxide compared with its crystalline counterpart, and propose lithium storage at structural defects in amorphous Molybdenum Dioxide. [5] The high Li storage performance of these amorphous materials leads to a proposition that the amorphous structure without crystalline organization may offer better lithium ion mobility. The majority of the study on the electrochemical behaviors of Fe<sub>2</sub>O<sub>3</sub> has been devoted to alpha-phased Fe<sub>2</sub>O<sub>3</sub> (also called Hematite). It is then interesting to develop controlled synthetic approach to prepare Amorphous Fe<sub>2</sub>O<sub>3</sub> nanostructures and explore their lithium storage properties.

Herein, we present surfactant-assisted synthesis of amorphous iron oxide nanosheets, which possess a high BET surface area of 233 m<sup>2</sup>/g. The Cyclic Voltammogram (CV) of the amorphous material shows different discharge potentials (vs. Li/Li<sup>+</sup>) from its crystalline counterparts, suggesting different lithium storage chemistry. The amorphous iron oxide exhibits a 50<sup>th</sup> cycle discharge capacity of 800mAh g<sup>-1</sup> at a current density of 100 mA g<sup>-1</sup> and demonstrates stability upon cycling. In this work, the rationale behind the CV difference and the stable cycling performance will be further studied by post-mortem analysis and electrochemical impedance spectroscopy, and discussed based on both structures and electrochemical properties.

## References:

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