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Graphitic carbon nitrides as anode materials for Li-ion batteries

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The graphite anodes commonly used in Lithium-ion Batteries (LIBs) are known to limit performance as they have a low number of electron transfer sites and slow electrode kinetics.[1] As various C,N based materials have shown significantly improved performance over graphite in electrochemical applications[2,3] there is interest in their use in LIBs.

In this work we investigate graphitic carbon nitride materials (gCNMs) as an alternative anode material for LIBs. These materials, like graphite, are layered structures but are formed from s-triazine or heptazine (tri-s-triazine) rings, linked by -N= or -NH- units and are therefore built on heteronuclear C-N bonds containing a high N:C ratio (>1).[4]

The gCNMs were synthesised via thermolysis of simple C,N containing precursors, such as melamine, at temperatures between 500 and 650 °C, after which extensive structural characterisation was performed. The resulting distinctive yellow material was processed into anodes after the addition of differing quantities of graphite (between 0 and 100% of active mass) to aid electrical conductivity, and electrochemical tests were performed.

It was shown that gCNMs were indeed capable of intercalating Li^+, even without the addition of conducting graphite, but performance was enhanced when graphite was present. This was shown to be due the semiconducting nature of the gCNM compounds. Although the composite electrodes were shown to have significantly higher capacities for Li^+ than those made of only gCNM, the capacity commonly achieved in graphite-anode batteries cannot currently be increased through the addition of gCNMs.

Keywords*: Lithium-ion Batteries; graphitic carbon nitride.*

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