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# CNT and graphene-based oxide composites for energy storage applications

Abstract
Numerous efforts have been reported regarding improving the rate capabilities of oxide-based intercalation materials by decreasing Li+ or Na+ diffusion length and increasing electronic conductivity. For example, nano-structured oxides were coated with conductive carbon layer to improve the electronic conductivity of oxides, thus providing a continuous electronically conductive network in the electrode. Various organic carbon sources such as glucose, sucrose, and citric acid were used to coat carbon layer on $NaTi_2(PO_4)_3$ NTP particles.[1] However, there is a growing concern that a carbon layer may hinder ion transport to oxide, thus limiting the rate capability, since thicker coating layer could act as a physical barrier to the transport of ions to the oxides.[2] There is an interplay of carbon layer between electron conduction pathways and physical barrier to the transport of Na+ ions.
As an alternative to conductive carbon coatings, nanocarbons such as 0 D carbon black, 1 D CNT and 2 D graphene have been employed to prepare metal-oxide/nanocarbon composites as an approach to provide electron conduction pathways to oxides, in which nanosized oxides were deposited on nanocarbons using solution-based synthesis.[3, 4] Since the morphology, size of metal oxides, and their contact nature with nanocarbons can be tuned by the surface properties of the underlying nanocarbon substrates, electrochemical properties of metal-oxide/nanocarbon composites should be compared and analyzed on the basis of not only different nanocarbon dimensions, but also surface properties of the underlying nanocarbon substratesIn this study, we report on the influence and mechanism of different dimensions and surface properties of the underlying nanocarbon substrates on the active NTP nanoparticles are investigated and rational design of the composites using nanocarbons are proposed.

## References

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