Phosphate-based composite electrodes for Li/Na-ion batteries: upscalable solution syntheses with in-situ solid carbon addition

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Since the success story of lithium iron phosphate, other phosphate-based compounds have attracted a lot of interest as promising candidates for positive electrodes in lithium-ion or sodium-ion batteries. Their electronic conductivity usually has to be improved through the preparation of composite powders ensuring intimate contact between the active material and conductive carbon. We report on the one-step synthesis of composite precursors using spray-drying or hydrothermal synthesis routes, two techniques which offer easy scaling-up of production. We show that addition of a solid carbon source (carbon black or carbon nanotubes) into the solution has a strong influence on the powder microstructure and is very effective in improving the battery cycling performance, taking our recent results on phosphates [Fex(PO4)(OH)y.zH2O)] and fluorophosphates [Na2FePO4F, Na3V2(PO4)2F3] as examples. We also compare this approach with the addition of the carbon source as a soluble precursor (such as ascorbic acid or citric acid) where the in situ formation of carbon is achieved by a heat treatment in inert atmosphere (typically argon).