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Low-temperature bio-inspired synthesis of functional oxides

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Oxide-based ceramics have been traditionally made via solid-state synthesis, which whilst reliable, suffers from several inherent drawbacks. Solid-state syntheses can be extremely slow, requiring many heating and processing steps to produce a phase pure final product. It also gives no control of size or morphology, a major disadvantage when nanoscale materials are required or beneficial. Products can suffer from poor homogeneity, particularly in cases where there are a large number of constituents.

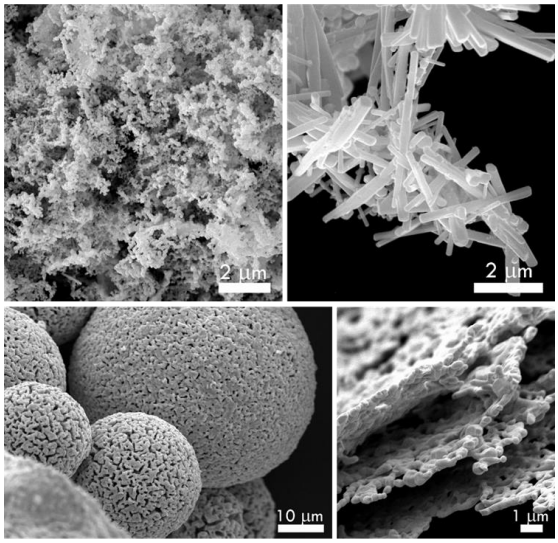

Figure 1. Example structures achievable using bio and solvent templating techniques.

Recently, bio- and solvent-mediated syntheses have been gaining popularity as a low-temperature way to create functional oxides.[1] The techniques give exquisite control over nanomorphology, and generally only require low temperatures to promote phase formation, e.g. growth of nanowires in complex oxide materials.[2] The chelating ability of many naturally occurring polymeric molecules make them highly effective at up-taking metal ions from solution, keeping them spatially separated during heating, circumventing many of the issues associated with traditional processing routes.

I will present the underpinning concepts of bio- and solvent- templating,[3] and give examples of the accessible structures and materials (Figure 1), for example nanowires,[2] and detail recent work on battery cathodes[4] and thermoelectric materials. I will demonstrate how the greater degree of control in these systems can be used to create improved function in oxide materials.

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References

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