Continuous Hydrothermal Synthesis of Nanoceramics; From Materials Discovery to Pilot Plant

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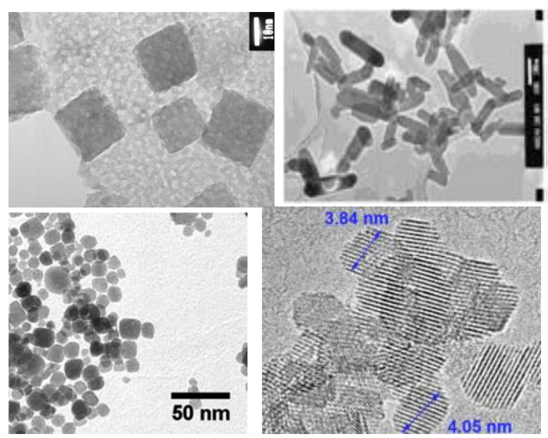
Introduction

Laboratory scale continuous hydrothermal flow synthesis (CHFS) systems for the controlled synthesis of inorganic nanoparticles (diameter <100 nm) have many potential commercial applications from catalysts to sunscreens and battery materials to fuel cell components. CHFS systems offer many advantages over batch processes: it is a green technology (using supercritical water as the reagent at >374°C and 22.1 MPa), and uses inexpensive precursors (e.g. metal nitrate salts), and parameters such as *T*, *P*, etc. can be controlled independently for the synthesis of high-quality, technologically-important functional nanomaterials in a single step (or fewer steps than conventionally used).[1-8]

The Clean Materials Technology Group at UCL,[9] has developed an engineered confined mixer,[4] which allows continuous running of a supercritical water CHFS system to prepare novel crystalline inorganic nanoparticle libraries. Via the CHFS route, these materials can be made directly or via further heat-treatment of intimately mixed precipitates (to form known "difficult to make" or hitherto unknown solid-state phases).[8] As well as the use of CHFS for materials discovery,[3] the talk will discuss the design and operation of a scaled-up CHFS Pilot Plant capable of Kg/h synthesis of nanoceramics as well as looking forward to the future. A recent review article on the topic has been published and gives an excellent overview to what can be done via this technology.[1]



TEM images of nanoparticles (<100nm) made via CHFS. a) 15 nm Co_3O_4 cubes, b) hydroxyapatite rods, c) In_2O_3 and (d) Ceria

References

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