# ABSTRACT:

## Direct Routes for the Sustainable Synthesis of Complex Advanced Functional Ceramic Materials

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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). The Clean Materials Technology Group at UCL, now use CHFS made intimately mixed metal oxide precipitates as precursors to the direct synthesis of “difficult to make” solid-state phases using only a single heat treatment step and no grinding (i.e., “Bake Without the Shake!”). This approach can be used for rapid materials discovery and also to manufacture materials using continuous, low energy manufacturing methods which are inherently scalable. As well as the use of CHFS for battery materials discovery, 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 future directions for the CHFS technology. A review article on the topic has been published and gives an excellent overview on the technology, see Darr JA, et al. “Continuous Hydrothermal Synthesis of Inorganic Nanoparticles: Applications and Future Directions”, ACS Chem. Rev. 2017, 117 (17), 11125–11238