Green Unconventional Supercritical Water Flow Routes to Energy Materials Discovery and Kg/h Scale-up

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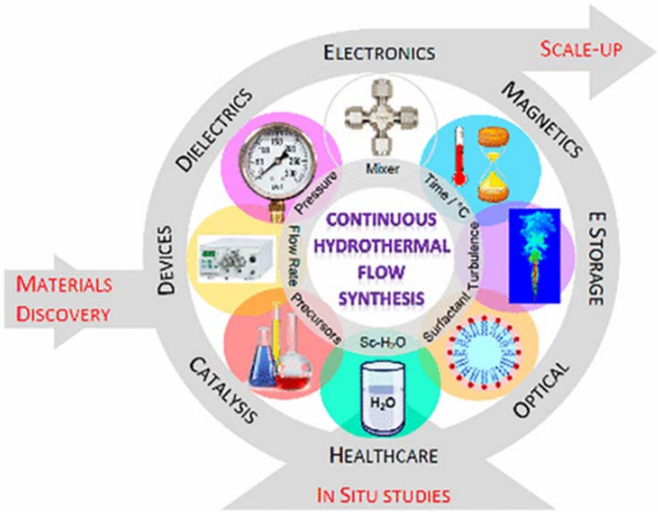
This talk will describe the collaborative endeavors of materials chemists and chemical engineers in the field of chemical and process engineering and nanomaterials discovery. A novel (unconventional) and green supercritical (sc-) continuous system will be described for making inorganic nanoparticles. Due to the exotic reaction conditions, this synthesis method enables the manufacture of nanomaterials that are difficult or impossible to make using more conventional synthesis techniques; directly giving highly crystalline doped nano-powders with very high surface areas (typically up to 300 m2g-1). The process also allows rapid fabrication of nanomaterial libraries via a high throughput serial approach. The precise control of conditions in the flow system allows influence over product characteristics (e.g. size, shape, etc.) for use in a variety of applications from solid oxide fuel cell materials, battery materials, doped titanias (dielectrics and photocatalysts) and dispersible ceramics. The talk will begin with a discussion of some of the amazing properties of supercritical water as well as engineering principles for the continuous process (which allows smooth operation and efficient mixing) as well as guiding principles for scale-up to a pilot plant capable of Kg/h production of nanoparticles. A few case studies will be provided to show current and future applications of such energy materials, some of which could have early commercial potential.



[1] See Continuous Hydrothermal Synthesis of Inorganic Nanoparticles: Applications and Future Directions. Darr et al Chem. Rev., 2017, 117 (17), 11125–11238