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Low Temperature Synthesis of Advanced Materials in Molten Salts

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Compared with conventional synthesis techniques, the so-called molten salt synthesis (MSS) technique shows several advantages: 1) the synthesis reaction can be completed at a relatively low temperature and in a short time; 2) in principle any kind of precursor can be used as a starting raw material; 3) the resultant product powders are generally homogeneous and well-dispersed, and have high surface reactivity; 4) grain shapes (spheroidal, platelet-shaped or lath/needle-shaped) and sizes (nanoscale to microscale) can be controlled/tailored; 5) the process is easy to perform, scalable and at a relatively low cost. Because of these advantages, MSS has attracted a great deal of research interest and been used extensively, in particular in recent years, to synthesise a range of advanced materials for many important applications. In this talk, the main work on MSS of structural and functional materials carried out at Exeter will be reviewed. The presentation starts with a brief background introduction, which is followed by a discussion on the two important MSS mechanisms, “dissolution and precipitation” and “template-growth” mechanisms. Their effects on MSS process as well as resultant products will be compared. The third part of the presentation focuses on MSS governed by the “template-growth” mechanism. Microstructures, properties and potential applications of some novel materials (such as spinel platelets and carbide nanorods/platelets/foams) synthesised *via* this route, will be introduced. Furthermore, the work on the *in-situ* formation of functional coatings or mono-dispersed nanoparticles, on different substrates (such as graphene or carbon nanotube) will be presented. Their applications in some important areas such as in armour, aerospace and hydrogen generation will be reviewed. In the fourth part of the presentation, the work on MSS controlled by the “dissolution and precipitation” mechanism will be highlighted. Microstructures, properties and applications of some nanomaterials (such as mullite whiskers, Si_3N_4 nanoplatelets, and SiC nanofibers) formed *via* this route will be introduced. In addition, the latest work on MSS of other non-oxide ceramics such as transition metal borides, sulphides and nitrides, and porous graphene (for water-treatment), will be presented. Finally, future work on MSS of other new materials will be suggested.

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