SUPERCRITICAL HYDROTHERMAL SOLUTION PROCESSING OF SOME HIGH MELTING NANOMATERIALS

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Hydrothermal technique is becoming popular in recent years to process advanced nanomaterials. The term hydrothermal is a broader terminology covering conventional hydrothermal, solvothermal and supercritical hydrothermal methods. The method has evolved so much that the high melting compounds could be crystallized under reduced temperature and pressure conditions. This is possible because of the progress achieved in the understanding of hydrothermal solution chemistry, and thermochemical computation. In this paper, the authors present the growth of advanced nanomaterials like rare earth vanadates - YVO_4 and $GdVO_4$ doped with active ions like Nd, Er and Eu; metal oxides – ZnO and TiO_2; and carbon polymorphs. All three materials have very high melting points, and have great application potential in various technological fields like solid state laser, biomedical, and microelectronics. The hydrothermal experiments were carried out within a wide range of temperature from 100 to 650 °C and pressures up to 2.5 kb. A number of mineralizers (both aqueous and non-aqueous) have been used in the synthesis. Similarly, a variety of surface modifiers have been used to alter the surface chemistry of these nanomaterials. Accordingly the nanomaterials obtained had greater variation in size, morphology and surface chemistry. Experiments were designed based on the thermodynamic calculations, and mainly focused on the control of size, morphology and surface chemistry of these advanced nanomaterials. Solubility and also crystal growth mechanism have been discussed. The nanomaterials processed were characterized by various techniques like powder XRD, FTIR, Laser Raman, Photoluminescence, SEM, DLS, BET surface area, etc.

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