Understanding the mechanism of formation of nano structured materials under hydrothermal conditions by in situ X-ray techniques

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Catalysis is the back-bone of chemical industries and they will continue to be essential in numerous applications that are indispensable to enhance quality of our life and society. Several types of heterogeneous catalysts, for example, supported catalysts, bulk oxides and nanoporous materials, are widely used for a variety of catalytic reactions. Within the family of heterogeneous catalytic systems, nanoporous materials (see figure 1) are highly effective for performing shape selective reactions and hence studied widely for a variety of catalytic applications. A variety of transition metal ions containing microporous materials have been synthesized and used as catalysts for the oxidation of organic compounds. To produce these nanoporous materials it is inevitable to use hydrothermal methods. Although, preparation of both the open and dense framework solids require considerable amount of effort to optimise the conditions, recent developments in the *in situ* methods, in particular X-ray diffraction and X-ray absorption spectroscopic techniques, offer considerable advantage to determine accurately the conditions required to produce phase pure materials and further more understand the mechanism of formation of these solids under operating conditions. Recent advances in these techniques allow us to collect high-quality time-resolved data to obtain the kinetics of crystallisation of solids prepared from amorphous gel mixtures. Here we will discuss the processes that take place during the crystallisation of open and dense framework structures under hydrothermal conditions.