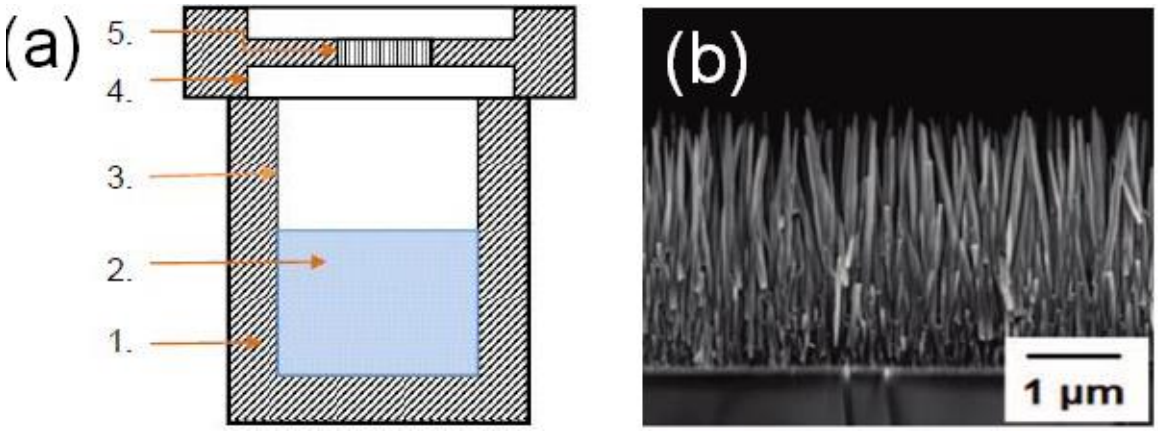
19CH201 – ENGINEERING CHEMISTRY FOR CIRCUIT BRANCHES
Unit-3 NANO CHEMISTRY

Hydrothermal method

Hydrothermal synthesis includes the various techniques of crystallizing substances from high-temperature aqueous solutions at high vapour pressures also termed "hydrothermal method.

Hydrothermal synthesis can be defined as a method of synthesis of single crystals that depends on the solubility of minerals in hot water under high pressure. The crystal growth is performed in an apparatus consisting of a steel pressure vessel called autoclave, in which a nutrient is supplied along with water. A gradient of temperature is maintained at the opposite ends of the growth chamber so that the hotter end dissolves the nutrient and the cooler end causes seeds to take additional growth.

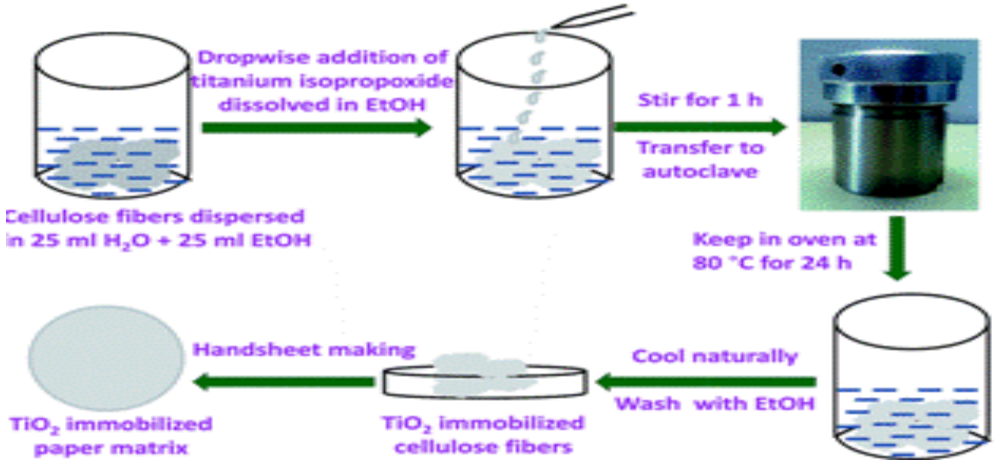
Advantages of the hydrothermal method over other types of crystal growth include the ability to create crystalline phases which are not stable at the melting point. Also, materials which have a high vapour pressure near their melting points can also be grown by the hydrothermal method. The method is also particularly suitable for the growth of large good-quality crystals while maintaining good control over their composition. Disadvantages of the method include the need of expensive autoclaves, and the impossibility of observing the crystal as it grows.



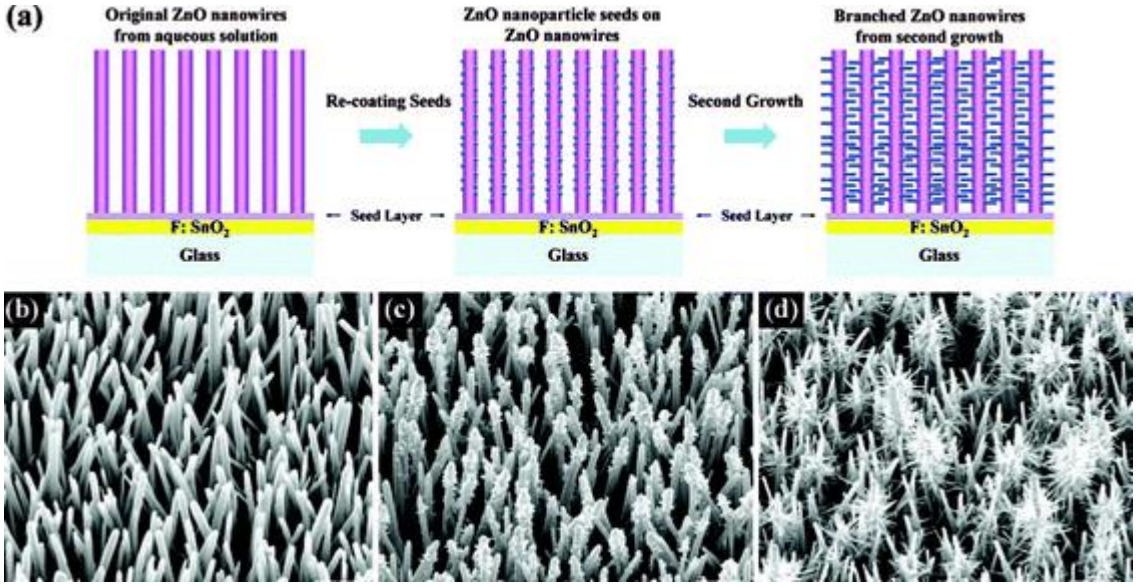
Hydrothermal method

Solvothermal synthesis

Solvothermal synthesis is a method for preparing a variety of materials such as metals, semiconductors, ceramics, and polymers. The process involves the use of a solvent under moderate to high pressure (typically between 1 atm and 10,000 atm) and temperature (typically between 100 °C and 1000 °C) that facilitates the interaction of precursors during synthesis.

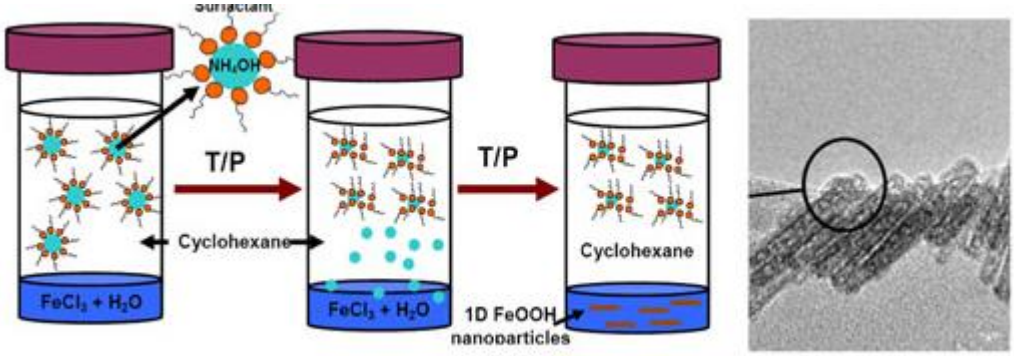


Solvothermal synthesis of zinc oxide



Zinc acetate dihydrate is dissolved in 2-propanel at 50^{o} C. Then the solution is

cooled to 0^{o} C and NaOH is added to precipitate ZnO. Then the solution is heated to 65^{o} C to allow ZnO growth for some period of time before a capping agent (1-dodecanethiol) is injected into the suspension to arrest the growth. The rod shaped ZnO nanocrystal is obtained.



Uses

This method can be used to prepare thermodynamically stable novel materials.

Electrodeposition

It is an important technique for synthesizing metallic nano-materials with controlled size and shape. Arrays of nano-structured materials with specific arrangements can be prepared by this method.