Crystallization Mechanisms in Closed Systems – A Zinc Oxide Study

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Crystalline zinc oxide presents many varied and useful characteristics both in relation to its chemical and physical properties. As a wide band gap semiconductor with a large excitation binding energy which also exhibits strong piezoelectric properties it has been proposed for many uses, ranging from antimicrobial activity to photoinduced degradation of pollutants to energy harvesting in solar cells.

This particular study concentrates on the use of microwave hydrothermal synthesis as a means of producing well-defined crystalline zinc oxide. In particular the specific mechanism by which nucleation and crystal growth in such closed systems has been studied by a variety of techniques including SEM, EDX, FTIR and XRD. Under such intense conditions of temperature (ca 120ºC) and pressure (ca 300kPa) the nucleation and growth processes are strongly influenced by the constituent ions and dissolved gaseous molecules in the local environment. Nucleation commences only when the microwave heating is terminated. The initial stage of crystal growth involves the irreversible expulsion of the dissolved gaseous molecules with the concurrent aggregation of prenucleation clusters (PNCs). Despite such forced conditions it is possible to synthesize well-defined crystalline zinc oxide rods in a straightforward manner using this approach.

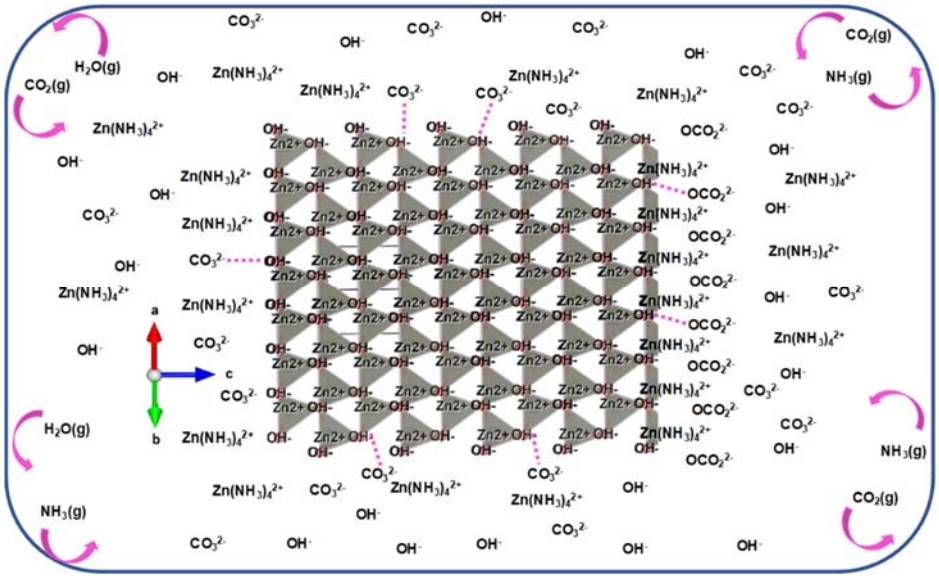

Fig 1. Schematic of a representative Prenucleation Cluster (PNC)

There will also be a short presentation on the development and recent construction of our new campus at Grangegorman in Dublin City including part of the new School of Chemical and BioPharmaceutical Sciences. Lessons learned through that process will be discussed. Watch here and here.

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