TIFR Centre for Interdisciplinary Sciences, Narsingi, Hyderabad 500075

Seminar

Self-assembly of ordered cylindrical nano-structures : A theoretical investigation of experimental results

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We present a theoretical model which elucidates the physical principles involved in the formation of very uniform *CdS* nanocylinders of different radii by combining the physics of flow, diffusion, self assembly and aggregation of constituent particles. Very recent experiments report that when *0.1* M solutions of $CdCl_2$ and Na_2S were allowed to mix through some anodised alumunium oxide (AAO) nanochannels, one observes the growth of an array of *CdS* nano-cylinders on only one end of the AAO template [A. Varghese and S. Datta, Phys. Rev. E . **85**, 056104 (2012)]. These cylinders have a pore along the center of the cylinder but closed at one end. The reaction happens only in the Na_2S chamber, and growth of cylinders of uniform size and shape continues as long as the supply of the reactant molecules ($CdCl_2$ and Na_2S) is maintained. To try to understand the physics of the observed phenomenon, we propose a model mechanism where the Cd^{+2} ions exit the AAO-nanochannel to enter Na_2S chamber with a finite velocity, these ions then react with the diffusing S^{-2} ions to form *CdS* which then self assemble to form cylinders of uniform width and cross-section. The flow of Cd^{+2} out of the AAO nano-channel is the key symmetry breaking feature which facilitates formation of uniform cylindrical structures of *CdS* instead of a *CdS* precipitate. Since our model does not crucially depend on the chemical details of the reaction, this mechanism can be extended to self-assemble other structures of relevance.

Tuesday, Nov 26th 2013

11:30 AM (Tea/Coffee at 11:15 AM)

Seminar Hall, TCIS