Dongsheng Li et al., J Nanomed Nanotechnol 2016, 7:4 (Suppl)
http://dx.doi.org/10.4172/2157-7439.C1.040



## *In situ* investigations of particle-mediated crystal growth

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Assembly of molecular clusters and nanoparticles in solution is now recognized as an important mechanism of crystal growth in many materials, yet the assembly process and attachment mechanisms are poorly understood. To achieve this understanding, we are investigating nucleation and assembly of iron and titanium oxides using *in situ* and *ex-situ* TEM, and the forces that drive oriented attachment between nanocrystals and the factors that control them via AFM-based dynamic force spectroscopy (DFS). Our hypothesis is that attachment is due to reduction of surface energy and the driving forces that bring the particles together are a mix dipole-dipole interactions, van der Waals forces, and Coulombic interactions. Therefore, they can be controlled via pH, ionic strength (IS), and ionic speciation. *In-situ* TEM shows that, in the iron oxide system, primary particles interact with one another through translational and rotational diffusion until a near-perfect lattice match is obtained either with true crystallographic alignment or across a twin plane. Oriented attachment then occurs through a sudden jump-to-contact. Analysis of the acceleration during attachment indicates it is driven by electrostatic attraction. *Ex-situ* TEM analysis shows that the TiO2 nanowire branching occurs through attachment of anatase nanoparticles to rutile wires on a specific crystallographic plane for which the anatase-to-rutile transformation leads to creation of a twin plane. Initial DFS measurements of the forces between (001) crystal basal planes of mica, and (001) planes of TiO2 show that the forces have strong relationship to pH, IS, and crystal orientation.

### Biography

Dongsheng Li completed her PhD in 2005 from Penn State University, majoring in Material Science and Engineering. Her PhD research focused on nanomaterials synthesis and characterization. She spent three years at Lawrence Berkeley National Laboratory as a Project Scientist, developing methods with *in situ* TEM and AFM to investigate particle nucleation and growth, and particle mediated crystal growth. She is currently a Staff Scientist at Pacific Northwest National Laboratory. She has published over 30 papers in respected journals and has been serving as a reviewer for journals such as *Journal of Physics, Nanotechnology* and *the Journal of the American Ceramic Society*, etc.

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