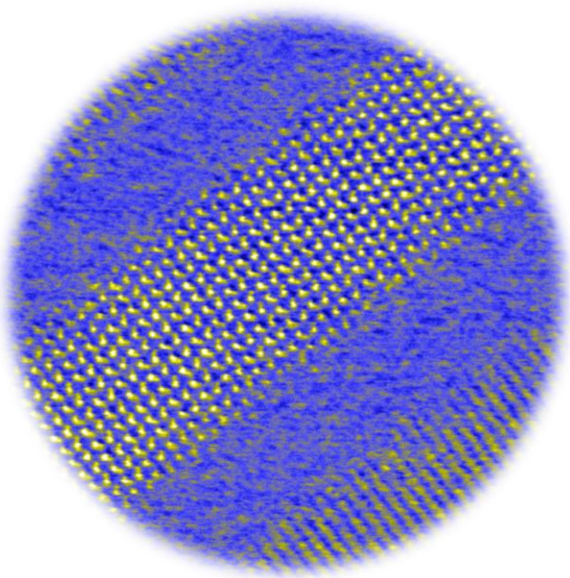
Atomic resolution characterization by TEM

M. Bar-Sadan

The ultimate goal of my research is to extend nanoscience into the atomic scale, where the atomic structure can be correlated with the overall physical and chemical properties. Working towards that goal, I focus on elucidating 3D atomic structure of nanoparticles. I will define and analyze internal interfaces and boundaries on lattice and atomic scales and correlate that with the chemistry and physics of the system. The aim is to understand the relation between the components of the interface and the linkage of structural features and physical properties through it and to relate the atomic structure with the reaction path and the reaction mechanism.

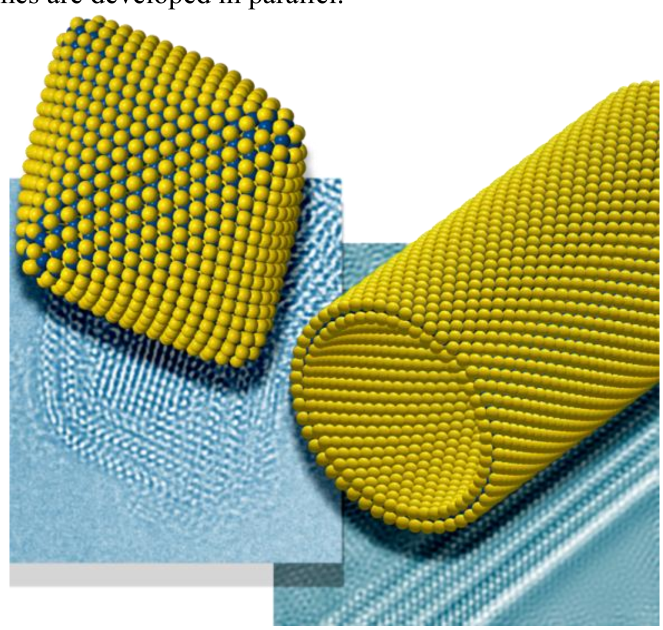
The expected significance of this research is both fundamental and applied: The direct knowledge on the chemical composition and atomic locations at the interface will enable correlation with observations done by different experimental techniques to produce the full understanding of the processes on the nano- and atomic-scale. By doing so, the rational design of nanostructures for various applications can be achieved through methodical prediction of their properties. In particular, I believe that physical properties like charge separation and charge transfer between different components of the nanoparticles, or optical activity, are crucially connected with the atomic scale reconstruction of boundaries within the particle. Moreover, classic synthetic routes of nanoparticles synthesis, e.g. cation/anion exchange, can be understood on the atomic scale.

One of the most powerful tools to achieve atomic characterization is transmission electron microscopy (TEM). The dramatic progress in hardware in recent years allows for the first time such analysis, if new acquisition modes, simulation aids and data analysis schemes are developed in parallel.



CdSe nanowire in atomic resolution

(synthesized by Banin group, HUJI)



MoS_2 fullerene and WS_2 nanotube in atomic resolution next to their atomic models

(synthesized by Tenne group, WIS)