# Nanocrystal Semiconductor Interactions in Clusters

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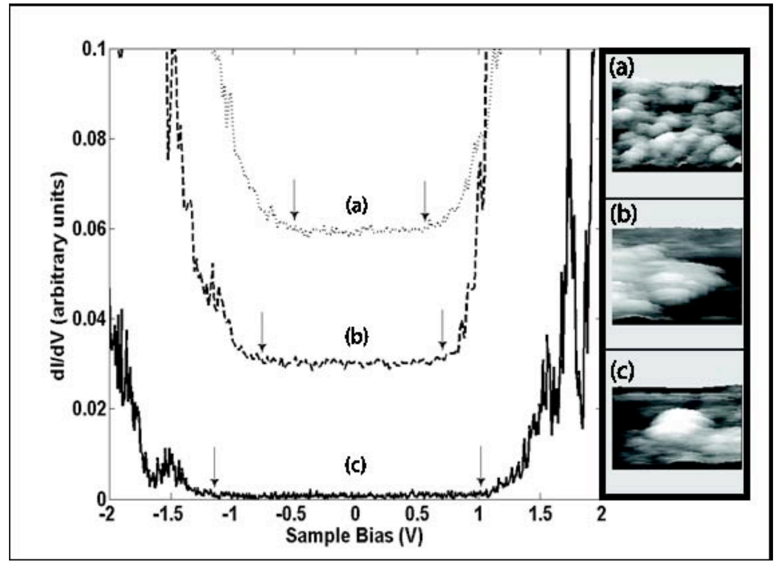
Quantum dots (QDs) are small clusters of atoms that form an essentially zero-dimensional structure. These clusters of atoms range in size from approximately 2 to 10 nm in diameter. QD electrical and optical properties vary from their bulk counterparts due to quantum confinement effects. The applications of quantum dots include light-emitting diodes (LEDs), bio-fluorescent tagging, and solar cells. Studying the properties of QDs allows for a better fundamental understanding of these structures and can potentially lead to more efficient devices.




Electronic properties of (a) center of cluster, (b) edge of cluster, and (c) isolated. Note that the flat regions indicated by arrows correspond to non-conductivity in the dots.

Using scanning tunneling microscopy (STM to image QDs with scanning tunneling spectroscopy (STS), one can obtain electronic properties on single dots. The plots in the figure to right shows the electronic properties measured on (a) a dot in the center of a cluster of dots, (b) a dot at the edge of a cluster, and (c) an isolated dot. This data shows that the non-conductive energy range (the flat region between the arrows) decreases with respect to the number of neighboring dots. This means that it is easier to inject electrons into a cluster of QDs rather than a single QD. Knowing this helps us better understand the electronic properties of QDs and can be used to increase the efficiency of quantum dot devices.

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