Molecular to quantum-dot nature in InP nanoclusters

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Nanoclusters, so called magic-sized clusters, are isolated intermediates in semiconductor nanocrystal syntheses, and they provide pivotal clues in understanding QD growth mechanisms.[1,2] Two families of heterogeneous-atom-incorporated InP nanoclusters containing chlorine or zinc atoms were directly synthesized from conventional molecular precursors and provide some answers for the InP QD growth mechanisms.[3] Basic InP nanocluster, named as 386-InP nanoclusters show a conversion by Cl insertion to InP:Cl nanoclusters, then to F399-InP:Cl nanoclusters. Similarly, zinc inserted F360-InP:Zn nanocluster could be converted to F408-InP:Zn nanoclusters, then to F393-InP:Zn nanoclusters. As these conversion proceeded, electronic evolution from molecule-like to QD-like characters was observed. Early stage nanoclusters showed negligible quantum confinement effect, which is characterized as nanomolecules. Later stage nanoclusters exhibited a distinct stark effect by photoinduced absorption. The crystal structure also gradually evolved from polytwistane in the early state InP nanocluster to zinc-blende in the later state InP nanocluster.

References

[1] D. C. Gary *et al*., Single-crystal and electronic structure of a 1.3 nm Indium phosphide nanocluster. *J. Am. Chem. Soc.* **2016,** *138*, 1510.
[2] Y. Kwon *et al*., Synthesis of InP branched nanostructures by controlling the intermediate nanoclusters. *J. Mater. Chemistry. A* **2020,** *8*, 1184.
[3] Y. Kwon *et al*., Evolution from unimolecular to colloidal-quantum-dot-like character in chlorine or zinc incorporated InP magic size clusters. *Nat. Commun.* **2020,** *11*, 3127.