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Colloidal Nanoheterostructures - State of the Art in Shape and Composition Control

Nowadays, we already encounter a precise control over sizes and shapes of colloidal nanocrystals which was developed by the colloid chemical community over several decades. This high degree of shape control, however, only applies to a limited material selection. The II-VI semiconductors CdSe and CdS are the presumably most prominent examples of such highly developed systems regarding size and shape control. A broad spectrum of shapes with narrow size distributions, ranging from dots, core-shell dots, rods, core-shell rods to tetrapods and octapods are available from these materials. Recently, these nanocrystals have been employed in a variety of cation exchange reactions, which allowed for changing the nanocrystals' entire cation frameworks, and at the same time fully conserving the anionic framework, so that the shape of the nanocrystals was maintained. In this talk a short summary of the state of the art in shape and composition control of colloidal nanocrystals will be presented and subsequently our most recent approaches to refine and improve this valuable tool named cation exchange reactions will be presented. For example, multi-step cation exchange reactions open the possibilities to exchange ions which were previously not possible to exchange by applying single step cation exchange reactions (such as the ion exchange sequence from Cd to Zn via an intermediate Cu ion exchange step).^{1,2} One of our research foci lies on developing a variety of e.g. nanoheterostructures by regio-selective cation exchange procedures in multiple steps. With this strategy we yield CdS/ZnS nanorods which exhibit a sharp and well-defined interface between the ZnS and the CdS domain, which so far was not realizable with traditional synthetic strategies (presumably caused by the pronounced lattice mismatch between ZnS and CdS). These segmented nanoheterorods are characterized in detail by means of optical characterization techniques and transmission electron microscopy.³ The versatility of the cation exchange approach for the synthesis of a large variety of nanoheterostructures will be demonstrated.⁴

- (1) Li, H. B.; Zanella, M.; Genovese, A.; Povia, M.; Falqui, A.; Giannini, C.; Manna, L. **Nano Lett.** 2011, 11, 4964.
- (2) Miszta, K.; Dorfs, D.; Genovese, A.; Kim, M. R.; Manna, L. **ACS Nano** 2011, 5, 7176.
- (3) Adel, P.; Wolf, A.; Kodanek, T.; Dorfs, D. **Chem. Mater.** 2014, 26, 3121.
- (4) Miszta, K.; de Graaf, J.; Bertoni, G.; Dorfs, D.; Brescia, R.; Marras, S.; Ceseracciu, L.; Cingolani, R.; van Roij, R.; Dijkstra, M.; Manna, L. **Nat. Mater.** 2011, 10, 872.