Colloidal Dual-Diameter Nanorods

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Semiconducting nanorods (NRs) have provided unique properties due to their 1-dimensional geometry, extending the potential with the control of composition and morphology. Especially, delicate control of NR diameter, which determines band states of the NR structure, is desired for a wide range of optical and electrical applications. Here, we firstly report dual-diameter NR structure which has two portions with different diameters along long axis of NR. For a distinct diameter formation in a single NR, activation of monomers was abruptly changed during the growth by utilizing big-sized seed as a nucleation site of the thick-diameter NR part. Both of the diameters are under quantum confinement regime, therefore band alignment and absorption properties can be engineered. Photogenerated carriers directionally transfer from the thin-NR part to thick-NR part because band-edge states are confined to the thick-diameter NR. We expect that this novel structure enables effective optical collection and directional charge transport, and the understanding of its growth mechanism gives insights for designing complex NR morphology at the nanometer-scale.