Nanocluster seed-mediated synthesis of CuInS$_2$ quantum dots, nanodisks, nanorods, and doped Zn-Ga-CuInS$_2$ quantum dots

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Supporting Information

**Figure s1.** a) UV-vis optical absorption spectrum of CuInS$_2$ nanoclusters. Inset image shows a photograph of the following compounds in dodecanethiol (DDT) at room temperature: I) CuCl, II) InCl$_3$, III) a mixture of Cu and In (1:1 molar ratio) and IV) CuInS$_2$ nanoclusters. b) XRD patterns for products obtained during the nanocluster formation stage with different Cu:In molar ratios. Increasing the molar ratio of Cu:In to 1:0.75 favors the formation of CuInS$_2$, while lower molar ratios result mixtures of Cu$_7$S$_4$ and CuS. c) FT-IR spectra of DDT, oleylamine (OLA), CuInS$_2$ nanoclusters and CuInS$_2$ nanoparticles. Inset image shows the weak S-H vibrations corresponding to DDT, which are present in pure DDT and in the nanoclusters. The absence of S-H vibrations in both clusters and the final CuInS$_2$ nanoparticles indicates the capping of CuInS$_2$ by DDT.
Figure s2. Distribution of the thickness of nanodisks.

Figure s3. Aliquots of CuInS$_2$ q-dots (first row), nanodisks (second row), nanorods (third row) collected at different temperatures.
**Figure s4.** XPS spectra of In 3d core electrons in CuInZnS.

**Figure s5.** Least-squares fit of the linear region of the optical absorption edge corresponding to different Ga/Cu starting molar ratios. (A - absorbance, h - Planck's constant, \( \nu \) - frequency).
Figure s6. a) Comparison of optical absorption spectra of CuInS$_2$, CuInZnS, CuInGaS$_2$ and Zn-CuInGaS$_2$, which shows the synergistic effect of cation combination on the absorption edge. b) Synergistic effect of Zn and Ga on band gap. The differences in the band gaps of CuInS$_2$, CuInZnS, CuInGaS$_2$ and Zn-CuInGaS$_2$ clearly show the overall effect of incorporation of both Ga and Zn.