Nanomaterials: Photoexcitation and Carrier Behavior

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Nanomaterials-based light-harvesting systems have attracted research interest because they can generate excitons upon photoexcitation. A deep understanding of hot carrier (HC) dynamics is crucial to improving the performance of optoelectronic devices by reducing thermalization losses. Here, we investigate the carrier dynamics, energy transfer, and charge-carrier dynamics of 2D CdSe nanoplatelets, metal clusters, and perovskite nanocrystals. We have elucidated how the electronegativity of surface staple motifs modifies the electron-phonon coupling in metal clusters, using temperature-dependent spectroscopic measurements and global analysis of ultrafast spectroscopy. Again, we have opted for a gold-doped silver bimetallic cluster to explore the effect of doping in single-molecule systems. Here, we demonstrated the influence of ligand-to-metal charge transfer (LMCT) on fluorescence properties, and the optimal hydrogen adsorption energy and efficient charge-transfer kinetics are the reasons for the superior HER activity in metal clusters.

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