Magic Semiconductor Clusters-Based Metal-Organic Frameworks: Boosting Photoluminescence and Catalytic Activity

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Controlled bottom-up assembly of nanobuilding blocks is major aims of nanotechnology with high stability and tunable structure, thus, results in potential applications in sensing, catalysis, so on. However, size and structure of conventional nanocrystals(NCs) inevitably are in distribution resulting in ensemble properties in assembly, which impede deep understanding single collective properties in nano-assembly. Semiconductor magic-sized nanoclusters (MSCs) with exact number of atoms have presented intriguing physicochemical properties which cannot be obtained in ensemble NCs, yet ambient instability has hindered their utilizations. Herein, MSCs-based MOFs, Mn^{2+}:$(CdSe)_{13}$ or Mn^{2+}:$(ZnSe)_{13}$ MSCs nodes, are designed, achieving enhanced stability and photoluminescence quantum yields (PLQYs) (>72% folds). Alloy Mn^{2+}:$(Cd_{1-x}Zn_xSe)_{13}$ SSs with atomic-level misibility are designed for tunable metal synergy; Mn^{2+}:$(Cd_{0.5}Zn_{0.5}Se)_{13}$ SSs exhibited highest catalytic activity for conversion CO_2 to cyclic carbonates under mild reaction conditions. The promoted PLQYs, stability, and catalytic activity through cooperated cluster-assembly and metal synergy cultivate the utility of semiconductor MSCs.