

Engineered core/shell quantum dots for injection laser diodes

임재훈[†]
아주대학교
(jhlhm@ajou.ac.kr[†])

Excellent light absorption and tunable band gap of colloidal quantum dots (CQDs) enable us to utilize this novel material as optical gain media for lasers. Since the first demonstration of optically-pumped lasing in 2000, numerous efforts have been made for low-threshold lasers. However, the electrically-pumped lasing of CQDs has never been achieved in spite of the excellence in optically-pumped lasers, mainly due to the ultrafast gain depletion by Auger recombination. Here, we realize for the first time the optical gain of CQDs by "direct" electrical current, which is an important milestone toward solution-processed injection laser diodes. An critical achievement in this work is a new class of type-I II-VI CQDs with smoothened confinement potential. This specially-designed electronic structure suppresses the Auger recombination of multiexcitons by controlling initial and final electronic states involving the Auger process. In a "current-focusing" device that reaches high direct current densities up to 18 A/cm^2 , we accomplished the optical gain of band-edge 1S states that is manifested by clear 1P state emission and specially-designed current-modulated transmittance measurement.