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Light radiating-manipulation in toroidal metamaterial by the gain in quantum dots JIE LI, ZHENGGAO DONG, Southeast University — Toroidal dipolar response in a metallic metastructure, composed of double flat rings, is utilized to manipulate the radiation pattern of a single dipolar emitter (e.g., florescent molecule/atom or quantum dot). Strong Fano-type radiation spectrum can be obtained when these two coupling dipoles are spatially overlapped, leading to significant radiation suppression (so-called nonradiating source) attributed to the dipolar destructive interference. Moreover, this nonradiating configuration will become a directionally super-radiating nanoantenna after a radial displacement of the emitter with respect to the toroidal flat-ring geometry, which emits linearly polarized radiation with orders of power enhancement in a particular orientation. Furthermore, via surface plasmon amplification with the assistance of the gain medium of PbS quantum dots, not only toroidal dipole response can be greatly strengthened but also the directional super-radiating intensity also obtains strong enhancement. Our results are promising in manipulating the radiation power and direction of a single emitter, such as fluorescent molecule/atom and quantum dot, by utilizing the intriguing toroidal dipolar response based on the proposed flat-ring metastructure.

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