

Simulation and experimental study of a 2D photonic crystal structure that reflects a quantum dots emission in the normal direction

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Abstrak

Two-dimensional photonic crystal structures not only confine light and guide waves laterally but also reflect light in the normal direction due to a slow Bloch mode effect. However, evidence of the utilization of this structure as a mirror is required. Therefore, in this work, a simulation was made and experimental results were obtained to prove that there was an increase in the intensity of reflected CdSe colloidal quantum dots emission in the normal direction when a 2D photonic crystal structure was used. A thin TiO₂ film was shaped into a two-dimensional photonic crystal structure using a simple sol-gel and polystyrene-mask-etching procedure. This structure was then placed on top of the thin CdSe quantum dots film layer. The emission of quantum dots onto the two-dimensional photonic crystal structure was compared to quantum dots emission onto a flat, thin TiO₂ film. An increase in the quantum dots emission of up to 105% was in the presence of the two-dimensional photonic crystal structure. This finding is very useful for photonic device applications, such as light-emitting diodes, laser systems and bio-tagging detection systems.

Studi Simulasi dan Eksperimen Struktur Kristal Fotonik Dua Dimensi sebagai Pemantul Emisi Kuantum Dot

Masalah Arah Normal. Kristal fotonika dua dimensi tidak hanya dapat mengukung cahaya dan memandu gelombang

ke arah sisi horizontal, tapi juga mampu memantulkan cahaya ke arah normal dikarenakan efek moda slow Bloch .

Namun bukti tentang penggunaan stuktur ini masih dibutuhkan. Untuk itu dalam penelitian ini hasil simulasi dan

percobaan telah didapatkan untuk membuktikan bahwa terjadi peningkatan pantulan emisi CdSe kuantum dot colloid

pada arah normal saat kristal fotonika dua dimensi digunakan. Sebuah lapisan tipis TiO₂ dibentuk menjadi kristal

fotonika dua dimensi denga menggunakan teknik sol-gel yang sederhana dan etching dengan menggunakan polystyrene. Struktur ini diletakkan di atas lapisan kuantum dot CdSe. Emisi dari kuantum dot di atas kristal

fotonika

dua dimensi dibandingkan dengan emisi kuantum dot di atas lapisan tipis dan datar TiO₂. Peningkatan emisi kuantum

dot hingga mencapai 105% berkat kehadiran kristal fotonika dua dimensi. Hasil ini sangat berguna untuk aplikasi

divais fotonika seperti LED, sistem laser dan sisten deteksi bio-tagging.