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 TiO_2. 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 detesi bio-tagging.