# Observation of enhanced optical gain in photonic crystals

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We present the measurement of gain length in photonic crystals doped with laser dye. A gain enhancement is experimentally observed for light propagating along the Γ-K symmetry direction in reciprocal space, while a strong inhibition is measured for directions characterized by a lower degree of crystal symmetry. These results are theoretically explained by comparing the optical gain to the calculated density of states along the crystal directions.

We find a six-fold increase of the gain in opal photonic crystal, as compared to the homogeneous film, and a more than 20-fold variation between Γ-K and less symmetrical directions, in the same photonic crystal. We explain this enhancement as due to a large increase of the density of the available modes around the Γ-K direction. Large variation of the gain in photonic crystal show the impact of the tailored density of states on light generation and amplification and open the way to enhancement of other phenomena like non-linear wave mixing and harmonic generation. Our result show how nanostructured media could be at the basis of the development of novel lasing sources with exceptional tunability, directionality and efficiency while being plastic photonics CMOS compatible, and candidates for in-board interconnections for future generation computers.