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2009

Start of mass-production of world's first 1310-nm quantum-dot laser for 10-Gbps communications (QDLaser)

~ Discrete Semiconductor/Others ~

Quantum dot laser

It is a semiconductor laser with nanometer size semiconductor fine particles (quantum dots) applied to the light emitting part, and it was proposed by Arakawa and Sakaki of the University of Tokyo in 1982. Since the emission of the quantum dot laser is determined by the quantum size effect of the quantum dot, the fluctuation of the light output of the laser accompanying the temperature change is greatly reduced as compared with the conventional laser which employs semiconductor physical properties sensitive to temperature change. In addition to it, it has superior characteristics of low power consumption, long distance and high-speed transmission and so on, far exceeding conventional semiconductor lasers. It is expected to become an innovative core technology to realize a high-performance light source for light communication with dramatically increasing information traffic.

Technology developed

In order to increase the speed of the quantum dot laser, it is necessary to increase the optical gain of the laser, and for that purpose, it is necessary to increase the number of the quantum dots. Quantum dots are fabricated by irradiating atomic beams of In and As onto a GaAs substrate placed in a high vacuum. When InAs is crystallized on a substrate, distortion occurs because the lattice constant of InAs is larger than that of GaAs, and the crystal is grown three-dimensionally so as to relieve the strain. Each one of these three-dimensional nanocrystals works as a quantum dot.

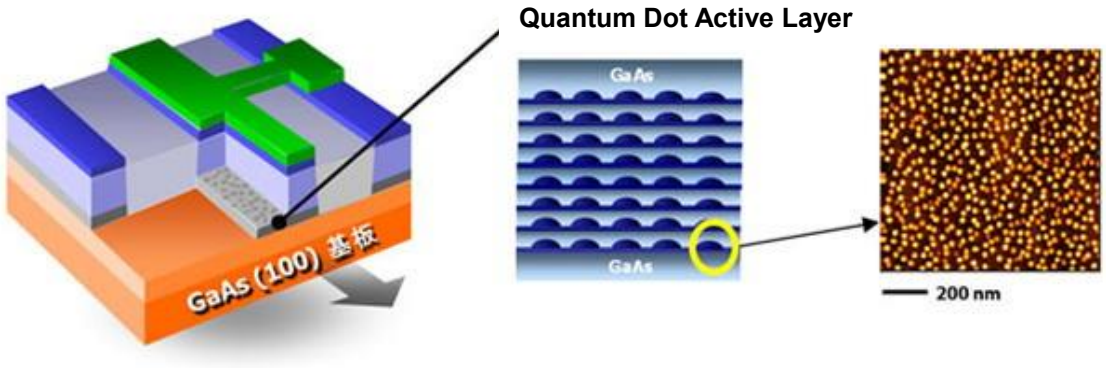
By optimizing the growth conditions for three-dimensional crystallization of quantum dots, the following technologies have been realized.

(1) A technique for densely arraying InAs quantum dots on a GaAs substrate. This realizes the number of 6×1010 quantum dots per 1 cm2.

(2) A technique for stacking quantum dot layers arranged at high density into multiple layers. As a result, it increased from the conventional 5 layers to 8 layers.

Performance of laser

The 10Gbps quantum dot Fabry-Perot laser achieved a characteristic temperature (T0) of 500K in the temperature range of 20°C. to 100°C. This value is about 10 times better than that of the conventional 1310nm semiconductor laser, and it recorded the world record as a mass production product.



Schematic of quantum dot laser structure

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