Growing High-Quality InAs Quantum Dots for Infrared Lasers

A deposition process has been modified to grow more nearly uniform quantum dots.

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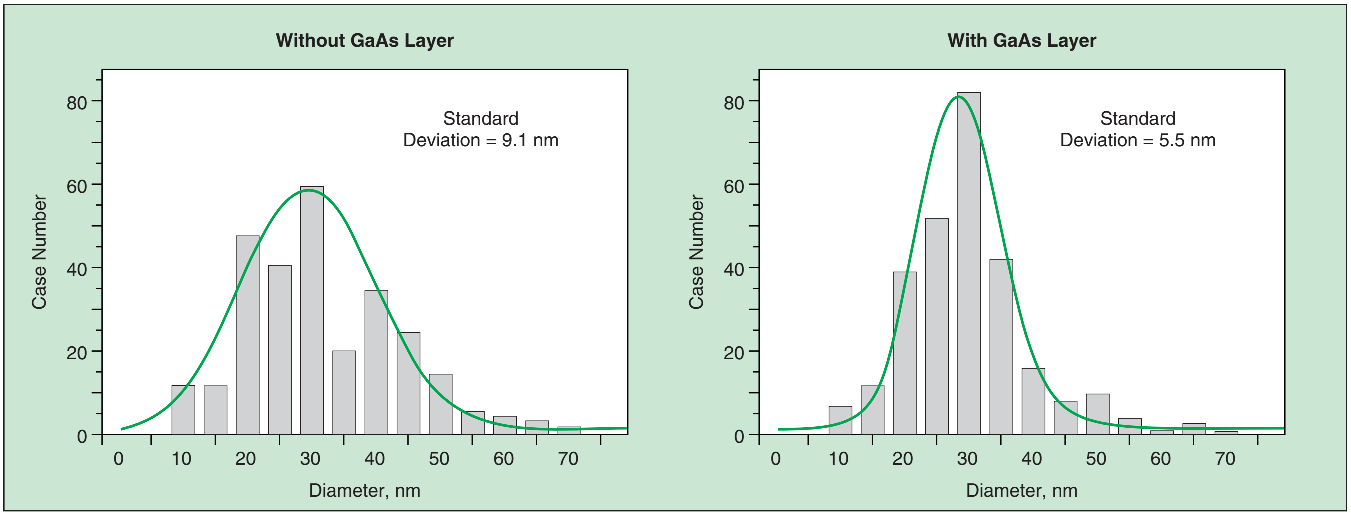

The **Distribution of Sizes** of InAs quantum dots is narrower (in other words, the dots are more nearly uniform) when a thin layer of GaAs is deposited before the quantum dots are deposited.

An improved method of growing high-quality InAs quantum dots embedded in lattice-matched InGaAs quantum wells on InP substrates has been developed. InAs/InGaAs/InP quantum dot semiconductor lasers fabricated by this method are capable of operating at room temperature at wavelengths ≥1.8 mm. Previously, InAs quantum dot lasers based on InP substrates have been reported only at low temperature of 77 K at a wavelength of 1.9 µm.

In the present method, as in the prior method, one utilizes metalorganic vapor phase epitaxy to grow the aforementioned semiconductor structures. The development of the present method was prompted in part by the observation that when InAs quantum dots are deposited on an InGaAs layer, some of the InAs in the InGaAs layer becomes segregated from the layer and contributes to the formation of the InAs quantum dots. As a result, the quantum dots become highly nonuniform; some even exceed a critical thickness, beyond which they relax.

In the present method, one covers the InGaAs layer with a thin layer of GaAs before depositing the InAs quantum dots. The purpose and effect of this thin GaAs layer is to suppress the segregation of InAs from the InGaAs layer, thereby enabling the InAs quantum dots to become nearly uniform (see figure). Devices fabricated by this method have shown near-room-temperature performance.

This work was done by Yueming Qiu and David Uhl of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*
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