MICRONOVA
CENTRE FOR MICRO- AND NANOTECHNOLOGY
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QUANTUM RINGS FABRICATED BY SELF-ASSEMBLY OF InAs ON InP

NANOTECHNOLOGY GROUP

OPTOELECTRONICS LABORATORY

Quantum rings (QRs) are ring shaped quantum dots with nanometer diameter. QRs have received great research attention in recent times due to their interesting electronic properties. Typically, capping self-organized InAs quantum dots (QDs) by a thin GaAs layer results in a morphology change from dot to ring. Two mechanisms, thermodynamic and kinetic, have been proposed to explain the growth phenomena of QRs. In the ongoing work, a novel method for QR formation has been developed.

RESULTS OVERVIEW:

In this work, quantum rings are fabricated by annealing as-grown InAs QDs in a phosphorus ambient. Unlike the typical method, no capping of dots is utilized to achieve the dramatic change in the QD morphology. The advantage of this QR fabrication process is that it separates the capping step from the ring formation. Thus, the capping of the rings can be studied separately. Moreover, it may allow the use of alternative capping materials, such as ternary or quaternary compounds in the design of InP-based QR structures.

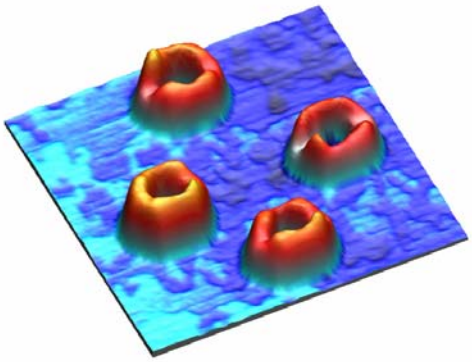

Figure 1: An atomic force micrograph of InAs islands on InP transformed into quantum rings.

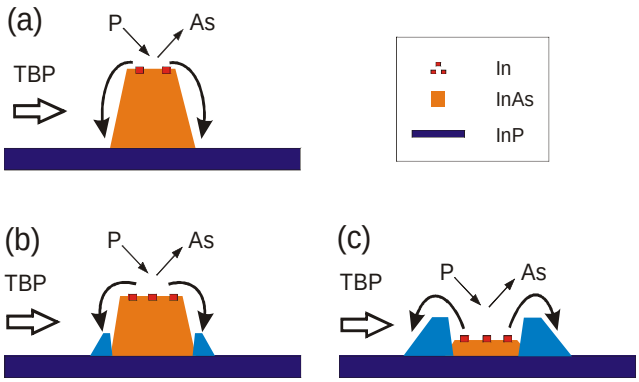

Figure 2: A schematic diagram of the formation principle of the QR. TBP is tertiarybutylphosphine.

Funding:

Academy of Finland

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Recent Publications:

1. J. Sormunen, J. Riikonen, M. Mattila, J. Tiilikainen, M. Sopanen, and H. Lipsanen, Transformation of self-assembled InAs/InP quantum dots into quantum rings without capping, Nano Letters 5, 1541-1543 (2005).
2. J. Sormunen, J. Riikonen, T. Hakkarainen, M. Sopanen, and H. Lipsanen, Evolution of Self-Assembled InAs/InP Islands into Quantum Rings, Japanese Journal of Applied Physics 44, L1323-L1325 (2005).