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标题: Terahertz Ionization of Highly Charged Quantum Posts in a Perforated Electron Gas
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来源出版物: NANO LETTERS 卷: 12 期: 3 页: 1115-1120 DOI: 10.1021/nl1044154 出版年: MAR 2012
在 Web of Science 中的被引频次: 1
被引频次合计: 1
引用的参考文献数: 29
摘要: "Quantum posts" are roughly cylindrical semiconductor nanostructures that are embedded in an energetically shallower "matrix" quantum well of comparable thickness. We report measurements of voltage-controlled charging and terahertz absorption of 30 nm thick InGaAs quantum wells and posts. Under flat-band (zero-electric field) conditions, the quantum posts each contain approximately six electrons, and an additional similar to 2.4 x 10(11) cm(-2) electrons populate the quantum well matrix. In this regime, absorption spectra show peaks at 3.5 and 4.8 THz (14 and 19 meV) whose relative amplitude depends strongly on temperature. These peaks are assigned to intersubband transitions of electrons in the quantum well matrix. A third, broader feature has a temperature-independent amplitude and is assigned to an absorption involving quantum posts. Eight-band k.p calculations incorporating the effects of strain and Coulomb repulsion predict that the electrons in the posts strongly repel the electrons in the quantum well matrix, "perforating" the electron gas. The strongest calculated transition, which has a frequency close to the center of the quantum post related absorption at 5 THz (20 meV), is an ionizing transition from a filled state to a quasi-bound state that can easily scatter to empty states in the quantum well matrix.
入藏号: WOS:000301406800001
语种: English
文献类型: Article
作者关键词: Terahertz; quantum dots; quantum posts; electron gas; ionization
KeyWords Plus: OPTICAL-PROPERTIES; DOTS; GROWTH; DEPENDENCE; ARRAYS
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出版商: AMER CHEMICAL SOC
出版商地址: 1155 16TH ST, NW, WASHINGTON, DC 20036 USA
Web of Science 分类: Chemistry, Multidisciplinary; Chemistry, Physical; Nanoscience & Nanotechnology; Materials Science, Multidisciplinary; Physics, Applied; Physics, Condensed Matter
学科类别: Chemistry; Science & Technology - Other Topics; Materials Science; Physics
IDS 号: 907GW
ISSN: 1530-6984
29 字符的来源出版物名称缩写: NANO LETT
ISO 来源出版物缩写: Nano Lett.
来源出版物页码计数: 6