Magnetoresistance Aharonov–Bohm oscillations in type-II InAsSbP ellipsoidal quantum dots

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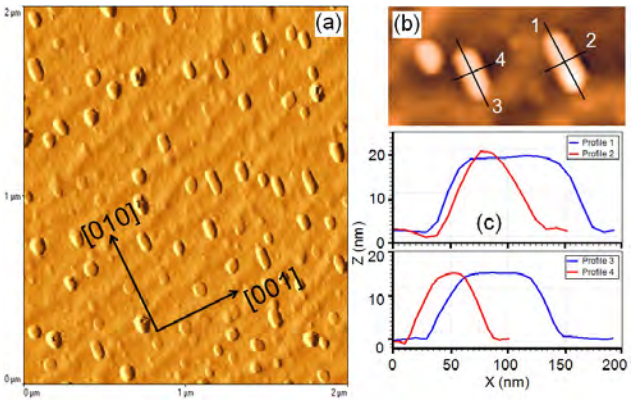
The InAsSbP composition type-II ellipsoidal quantum dots (QDs) are grown on InAs(100) substrate from In-As-Sb-P quaternary liquid phase in Stranski--Krastanow growth mode. Device structures in the form of photoconductive cells are prepared for investigations. Magnetospectroscopy and high-precision capacitance spectrometry are used to explore the QDs structure's electric sheet resistance in magnetic field and the capacitance law at lateral current flow. Aharonov--Bohm (AB) oscillations with the period of δB=0.38±0.04 T are found on the magnetoresistance curve at both room and liquid nitrogen temperatures. The influence of the QDs size distribution on the period of AB oscillations is investigated. The values for both major and minor semiaxes of ellipsoidal QDs were theoretically calculated by the equation for the period of Aharonov-Bohm oscillations. Comparison of calculated and experimentally measured values shows that they are coincide with high accuracy. The magnetoresistance hysteresis equals to ~50 mΩ and ~400 mΩ is revealed at room and liquid nitrogen temperature, respectively. At increasing with continuously decreasing of applied voltage, the capacitance hysteresis (CH) and contra-directional oscillations are also detected. Behavior of the CH value versus applied voltage frequency in the range of f = 103--106 Hz is investigated. It is shown that the CH value decreases with increasing frequency up to 104 Hz, becomes constant (slightly increases) in the range of 104--105 Hz, continues decreasing and equals to zero at f0=7×105 Hz. The time constant for the QDs R--C parallel circuit (generator) is calculated.



Ellipsoidal quantum dots.jpg