Electron-dipole resonance of impurity centres embedded in silicon microcavities

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We present the findings of the electron-dipole resonance of the iron-boron pairs embedded in silicon microcavities, which is identified in the studies of the excitation spectra by means of FIR spectroscopy.

The short-time diffusion of boron was carried out from the gas phase into the n- type Si(100)-wafers. The ultra-shallow diffusion profiles (5÷30 nm) prepared were studied using the SIMS, Cyclotron Resonance (CR), Infrared Fourier spectroscopy and Scanning Tunneling Microscopy (STM) techniques. The cyclotron resonance (CR) angular dependencies and current-voltage (CV) characteristics brought about the deflection of the bias voltage from the normal to the p-n junction plane show that the ultra-shallow p^+-diffusion profiles consist of the low density p-type quantum wells (SQW) divided by heavily doped δ - barriers. Space-independent excess fluxes of intrinsic defects that cause the formation of SQW appear to be transformed also into microdefects which can be revealed by the STM technique as the deformed potential fluctuations (DPF) on the surface of the ultra-shallow diffusion profiles. The STM images show that the DPF effect gives rise to the self-organization of the microdefects in the fractal-type microcavities incorporated into the SQW series. These silicon microcavities that exhibit a distributed feedback are revealed by the spectral dependencies of both the absorption and transmission coefficient. The concentration of residual iron-boron pairs inside the p^+-ultra-shallow diffusion profile was observed by the ESR and EDESR techniques. The optically induced intraband transitions in SQW are observed to result in the Auger process that transforms the FeB pairs in the excited state which split into spin multiplet as a result of strong *sp-d* exchange interaction. These spin-dependent transitions due to the localization of photoexcited holes on the FeB pairs in SQW are found to be enhanced by the interplay with the microcavity modes thereby giving rise to the electron-dipole resonance in the range of the Rabi splitting that is revealed by the transmission spectral dependencies in the absence of the external magnetic field (Fig.1). The angular dependencies of the electron-dipole resonance spectra appear to exhibit the trigonal origin of the FeB pairs emebedded in silicon microcavities.

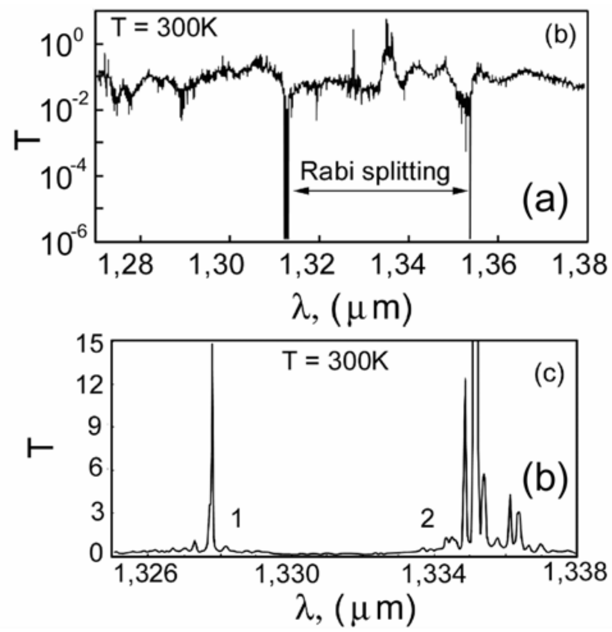

Fig.1. Transmission spectra that exhibit the intraband photoluminescence from SQW and the electron-dipole resonance spectrum of the trigonal FeB pair, which are embedded in the silicon microcavity.