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Cyclotron Resonance in Ge Layers in $Ge_{1-x}Si_x$-Ge Strained Heterostructures

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We report the first investigation of cyclotron resonance (CR) of photogenerated carriers in undoped $Ge_{1-x}Si_x$-Ge heterostructures grown on Ge(111) (45 Ω·cm) substrate by CVD technique [1,2]. The quantum well structure (QWS) used in the experiments consists of 243 period of 180 Å- thick Ge wells and 320 Å-thick $Ge_{0.87}Si_{0.13}$ barriers. The peculiarity of such QWS is the elastic deformation arising from the mismatch of lattice periods of Ge and $Ge_{1-x}Si_x$. In our case the deformation corresponds to uniaxial stretch by P= 6.0 kbar along QWS axis. GaAs light-emitting diode has been used to exite photocarriers.

Figures 1a and 2 show the microwave absorption and microwave photoresponse spectra (T = 4.2K, λ = 2.3 mm). Wide CR line is observed in both spectra. The experiments with the polarized radiations indicate that this line is associated with the CR absorption of positive charge carriers. The effective mass estimated from the peak position differs from the effective masses both light (m_l=0.042m_o) and heavy holes (m_h=0.39m_o), and the half-width of this line corresponds to inverse relaxation time $1/\tau = 3 \cdot 10^{11} c^{-1}$. It is clearly seen that this line is sufficiently wider than that in the bulk Ge (Fig.1b). Thus, it is concluded that we observed CR of holes at the bottom of QW in strained Ge layers.

Figure 2 shows that persistent photoconductive effect occurs in such QWS at low temperature (T = 4.2 K). The CR line arises in photocondutivity spectrum under interband illumination (Fig.2a) and did not disappear when light exposure was over (Fig.2b). The latter indicates that the spatial separation of photoexited holes and electrons takes place. The electron seems to be captured by some traps, that also explains the absence of electron line in CR spectrum.

1.Orlov L.K. et al. Sov.Phys.JETP, 1990, v.71, N3, p.573.
2.Kuznetsov O.A. et al. JETP Lett., 1991, v.54, N6, p.347.

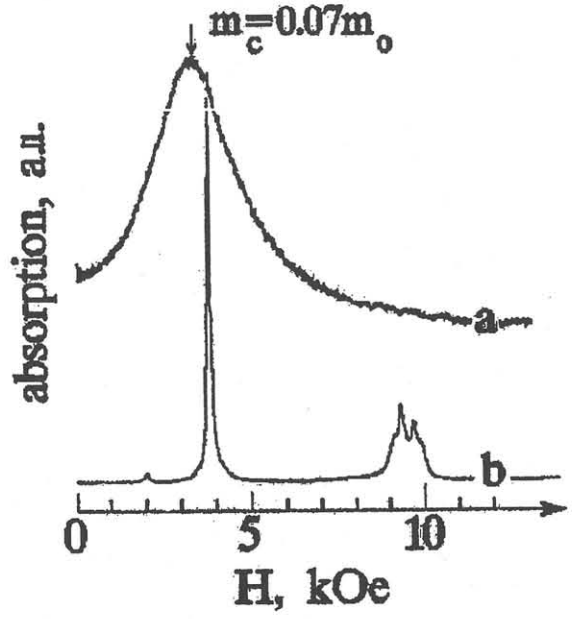

Figure 1

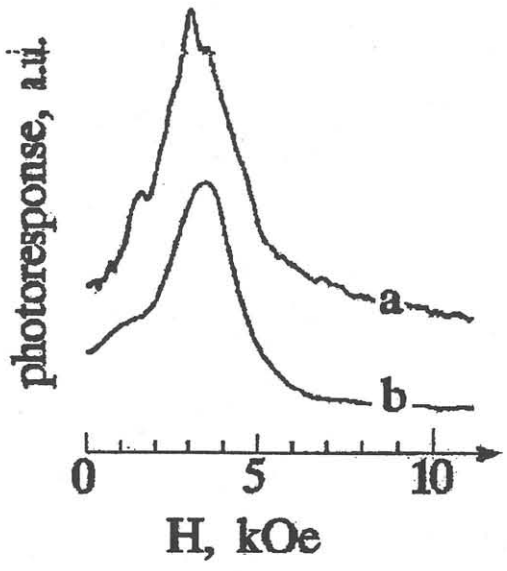

Figure 2