

Pressure effects on neutral and charged excitons in self-assembled (In,Ga)As/GaAs quantum dots

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(Received 28 May 2005; revised 20 July 2005)

Abstract We report the pressure dependence of the optical properties of self-assembled (In,Ga)As/GaAs quantum dots. The exciton binding energy decreases with increasing pressure, while the electron-hole recombination rate increases. The pressure dependence of the exciton binding energy is found to be in agreement with the theory of the exciton radius variation. The electron-hole recombination rate is found to increase with increasing pressure, with a saturation behavior observed at higher pressures. The electron-hole recombination rate is found to be proportional to the exciton binding energy. The electron-hole recombination rate is found to be proportional to the exciton binding energy.

DOI: 10.1103/

.72.041307

$$\mathcal{E}^{(e)} = \mathcal{E}^{(h)}$$



$$\begin{aligned}
\Delta_{\perp}(X^0) &= [\mathcal{E}_0^{(e)} - \mathcal{E}_0^{(h)}] - E_{\perp}(X^0), \\
\Delta_{\perp}(X^-) &= [\mathcal{E}_0^{(e)} + E_{\perp}(X^0)] - E_{\perp}(X^-), \\
\Delta_{\perp}(X^+) &= [-\mathcal{E}_0^{(h)} + E_{\perp}(X^0)] - E_{\perp}(X^+), \\
\Delta_{\perp}(XX^0) &= 2E_{\perp}(X^0) - E_{\perp}(XX^0).
\end{aligned} \tag{5}$$

$$\begin{aligned}
\Delta_{\perp}(X^0) &= J_{00}^{(eh)}, \\
\Delta_{\perp}(X^-) &= J_{00}^{(eh)} - J_{00}^{(ee)}, \\
\Delta_{\perp}(X^+) &= J_{00}^{(eh)} - J_{00}^{(hh)},
\end{aligned} \tag{6}$$

$$\Delta_{\perp}(XX^0) = 2J_{00}^{(eh)} - [J_{00}^{(ee)} + J_{00}^{(hh)}] = \Delta_{\perp}(X^-) + \Delta_{\perp}(X^+).$$

$$\delta(\chi^q) = \Delta_{\perp}(\chi^q) - \Delta_{\parallel}(\chi^q). \tag{5}$$

$$\Delta_{\perp}(\chi^q) = \Delta_{\parallel}(\chi^q)$$

$\delta(\chi^q)$.
W_m
 $a - a_0$
m
W_m
m
W_m
m
W_m
m
 $\Delta a/a_0 = (a - a_0)/a_0$,
1()
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$$\begin{aligned} & \left(\frac{\partial}{\partial t} \psi_0^{(s)}(\mathbf{r}, t) + i \frac{\partial}{\partial \mathbf{r}} \cdot \mathbf{A}_c(\mathbf{r}, t) \psi_0^{(s)}(\mathbf{r}, t) \right) = -i \frac{e}{\hbar} \mathbf{E}_c(\mathbf{r}, t) \psi_0^{(s)}(\mathbf{r}, t) \\ & \text{with } \mathbf{A}_c(\mathbf{r}, t) = \frac{e}{m_e} \mathbf{v}_0^{(s)}(\mathbf{r}, t) \times \mathbf{B}_c(\mathbf{r}, t) \\ & \text{and } \mathbf{E}_c(\mathbf{r}, t) = -\frac{e}{m_e} \mathbf{v}_0^{(s)}(\mathbf{r}, t) \times \mathbf{A}_c(\mathbf{r}, t) - \frac{e}{m_e} \mathbf{v}_0^{(s)}(\mathbf{r}, t) \times (\mathbf{v}_0^{(s)}(\mathbf{r}, t) \times \mathbf{B}_c(\mathbf{r}, t)) \\ & \text{and } \mathbf{v}_0^{(s)}(\mathbf{r}, t) = \frac{1}{m_e} \mathbf{p}_0^{(s)}(\mathbf{r}, t) + \frac{e}{m_e} \mathbf{v}_0^{(s)}(\mathbf{r}, t) \times \mathbf{B}_c(\mathbf{r}, t) \end{aligned}$$