Excitonic exchange effects on the radiative decay time of monoexcitons and biexcitons in quantum dots

G A. ,* G B , A F , A
National Renewable Energy Laboratory, Golden, Colorado 80401, USA
(30 2006; 17 2006)

E k . k ( ), (I ,A)G /G A C. $\tau_R(X^0)$ k . I k , $\tau_R(XX^0)$. $\tau_R(X^0)/\tau_R(XX^0)$ 4 2 . F (I ,G)A /G A , *et al.* [. B **73**, 165305 (2006)]. $\tau_R(X^0)/\tau_R(XX^0)$ *et al.*, . C ,

D I: 10.1103/ B.74.205422 AC ( ): 73.21. , 71.35. , 78.60.

I. INTRODUCTION: RELATION BETWEEN APPARENT AND MICROSCOPIC CARRIER DECAY

$\tau_R(X^0)$ $\tau_R(XX^0)$. E 1665 1665 1665 D 3011665 -3011665 - 3011665 -3 3011665 11665 1 -21 4270459.1 01 [F . 1( )].

[1,3] F C_{2v} (I ,G)A /G A -*d* k . 2 20 .

[4,5] I $e_0^2h_0^2$ $e_0^1h_0^1$ [F . 1( )].

I ( )

$\tau_R(X^0)$ k τ_{BD} $R_{BD}=\tau_{BD}^{-1}$. B [6] B (R_{B0}) D (R_{D0}) R_{D0} $\simeq R_{B0}$, τ_{BD}, $R_{B0}/2$ ( ) R_{0B} R_{0D} k $R_{0B}\simeq R_{B0}$ $R_{0D}\simeq R_{D0}$ $\tau(XX^0)\simeq 2R_{0B}^{-1}$ R_{BD}. ( ) R_{BD}, $\tau_R(X^0)/\tau_R(XX^0)$ 4 2 k ,[7] $\tau_R(X^0)/\tau_R(XX^0)\simeq 2$, $\tau_R(X^0)$ $\tau_R(XX^0)$ [8] $\tau_R(X^0)/\tau_R(XX^0)\simeq 4$. I $_{0.6}$G $_{0.4}$A /G A C.

II. RATE EQUATIONS FOR THE RADIATIVE DECAY OF THE MONOEXCITON

F 1( )

F Fig. 1( ) R_{ij}.

Fig. 1( ) $n_0(t)$ $e_0^1 h_0^1$ $e_0^0 h_0^0$:

$$dn_b/dt = (R_{bb'} + R_{bd} + R_{bd'} + R_{b0})n_b + R_{d'b}n_{d'} + R_{db}n_d + R_{b'b}n_{b'},$$

$$dn_{b'}/dt = (R_{b'b} + R_{b'd} + R_{b'd'} + R_{b'0})n_{b'} + R_{d'b'}n_{d'} + R_{db'}n_d + R_{bb'}n_b,$$

$$dn_d/dt = (R_{db} + R_{d'b'} + R_{dd'} + R_{d0})n_d + R_{d'd}n_{d'} + R_{b'd}n_{b'} + R_{bd}n_b,$$

$$dn_{d'}/dt = (R_{14} + R_{13} + R_{12} + R_{10})n_{d'} + R_{dd'}n_d + R_{b'd'}n_{b'} + R_{bd'}n_b,$$

dt

E . (6)

$I(t) = R_{B0}\, n_B(t) + R_{D0}\, n_D(t)$,

( )

III. RATE EQUATION FOR THE RADIATIVE DECAY OF THE BIEXCITON

T *B-D*

$$F = \frac{1}{2}\left(\frac{R_{B0} \quad \square_S}{\square_F \quad \square_S}\right), \qquad (12)$$

$$S = \quad \frac{1}{2}\left(\frac{R_{B0} \quad \square_F}{\square_F \quad \square_S}\right). \qquad (13)$$

I [illegible] $I(t)$ [illegible] :
dn_0/dt [E . (6)], [illegible] $R_{D0}=0$ [illegible]
[illegible] $I(t)=R_{B0}\, n_B(t)$. [illegible]
[illegible] $I(t)$ [illegible]
[illegible] ([illegible]) [illegible].

I . , . . .

D et al.[9] F et al.,[13]

$\gamma_R(X^0) \simeq R_{B0}^{-1} = 1.1$ I $_{0.6}$G $_{0.4}$A /G A

B et al.,[14]

1.55

1 B k et al.[15] et al.[16] I C