Electrical properties of Gallium Antimonide (GaSb)

Electrical properties

Basic Parameters

- Breakdown field \( \approx 5 \times 10^4 \) V/cm
- Mobility electrons \( \leq 3000 \) cm\(^2\) V\(^{-1}\) s\(^{-1}\)
- Mobility holes \( \leq 1000 \) cm\(^2\) V\(^{-1}\) s\(^{-1}\)
- Diffusion coefficient electrons \( \leq 75 \) cm\(^2\) s\(^{-1}\)
- Diffusion coefficient holes \( \leq 25 \) cm\(^2\) s\(^{-1}\)
- Electron thermal velocity \( 5.8 \times 10^5 \) m/s
- Hole thermal velocity \( 2.1 \times 10^5 \) m/s

Mobility and Hall Effect

Electron Hall mobility versus temperature for different doping levels.
- \( N_d = 1.7 \times 10^{18} \) cm\(^{-3}\)
- \( N_d = 2.8 \times 10^{17} \) cm\(^{-3}\)

Broken curves represent the experimental data. Continuous curves represent theoretical calculations. (Mathur and Jain (1979)).

Hole Hall mobility versus temperature at different compensation levels.
- \( N_a^- = 1.39 \times 10^{17} \) cm\(^{-3}\); \( N_d = 9 \times 10^{15} \) cm\(^{-3}\)
- \( N_a^- = 1.3 \times 10^{17} \) cm\(^{-3}\); \( N_d = 9.5 \times 10^{16} \) cm\(^{-3}\)
- \( N_a^- = 1.1 \times 10^{17} \) cm\(^{-3}\); \( N_d = 9.5 \times 10^{16} \) cm\(^{-3}\)

(Nakashima (1981)).

Temperature dependence of hole Hall mobility.
MBE technique. Hole concentration at 300 K:
- 1. \( 2.28 \times 10^{16} \) cm\(^{-3}\)
- 2. \( 1.5 \times 10^{16} \) cm\(^{-3}\)

(Johnson et al. (1988)).

The hole Hall mobility versus hole concentration, 300 K.
Experimental data are taken from five different papers (Wiley (1975)).

Transport Properties in High Electric Fields
Calculated field dependence of the electron drift velocity, 300 K. 
(Ikoma et al. (1980)).

Calculated (solid) and experimental (points) current density dependencies versus the electric field, 300 K. 
(Jantsch and Heinrich (1971)).

Fraction of electrons in $\Gamma$, $L$, $X$ valleys as a function of electric field, 300 K.

$n = 6.8 \times 10^{16} \text{ cm}^{-3}$
(Jantsch and Heinrich (1971)).

Electron temperature as a function of the electric field, $T=77$ K.

full and open circle - experimental data
curve are calculated (Jantsch and Heinrich (1971)).

Impact Ionization

The dependences of $\alpha_i$ and $\beta_i$ versus $1/F$. $T=77$ K

Open symbols : $F$ (111).
Filled symbols : $F$ (100).
(Zhingarev et al. (1981)).

The dependences of $\alpha_i$ and $\beta_i$ versus $1/F$. $T=300$ K

$F$ (100).
(Hildebrand et al. (1980)).

Recombination Parameters

Radiative lifetime versus donor concentration, $T=77$ K, GaSb(Tc).
To extract these dependences from experimental data the values of internal quantum efficiency $\eta$ were taken:
open circles $\eta=0.8$;
filled circles $\eta=1$;
(Agarev et al. (1984)).
Nonradiative lifetime versus donor concentrations, \( T = 77 \) K, GaSb(Se).

- Open circles \( \eta = 0.8 \);
- Filled circles \( \eta = 1 \); (Agaev et al. [1984]).

Electron radiative (triangles) and nonradiative (squares) lifetime versus acceptor concentration, \( p \)-GaSb, \( T = 77 \) K. (Titkov et al. [1986]).

Electron lifetime versus temperature at different acceptor concentrations.

\( N_a (cm^{-3}): 1. 5 \cdot 10^{18}; 2. 2.2 \cdot 10^{19}; 3. 3.5 \cdot 10^{19}. \) (Titkov et al. [1986]).

Radiative recombination coefficient \( \sim 10^{-10} \) cm\(^3\) s\(^{-1}\)

Auger coefficient

\( 77 \) K

- \( 2 \cdot 10^{-29} \) cm\(^6\) s\(^{-1}\)
- \( 5 \cdot 10^{-30} \) cm\(^6\) s\(^{-1}\)

\( 300 \) K

- \( 2 \cdot 10^{-29} \) cm\(^6\) s\(^{-1}\)
- \( 5 \cdot 10^{-30} \) cm\(^6\) s\(^{-1}\)