Computer-Aided Design Consideration on Low-Loss p-i-n Diodes

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Abstract—Two methods are presented to realize a low forward-voltage p-i-n diode with a thin i region. One is to increase recombination current by appropriately controlling carrier lifetime in the i region. The recombination current for a constant voltage reaches a maximum at a carrier lifetime given by $(q/kT)\, W_i^2/8\mu_i$, where W_i and μ_i are thickness and effective mobility of the i region, respectively. The other is to increase diffusion current in the p emitter by decreasing carrier lifetime only for the high impurity concentration region.

On the basis of the first method, diodes with a 0.83-V forward voltage at 150 A/cm^2, a 200-V reverse voltage, and a 50-ns reverse recovery time were obtained.

NOTATION

q	Unit charge, = 1.6×10^{-19} C.
k	Boltzmann's constant, = 1.38×10^{-23} J/deg.
T	Absolute temperature, = 300 K.
τ_n, τ_p	Electron and hole lifetimes.
τ	Component lifetime, determined by lifetime killers.
τ_i	Component lifetime, determined by the amount of doped impurities.
τ_{ne}, τ_{pe}	Electron lifetime in p emitter, and hole lifetime in n emitter.
n, p	Electron and hole densities.
N_D, N_A	Donor and acceptor concentrations.
Γ_n, Γ_p	n-emitter and p-emitter impurity concentrations.
D_{ne}, D_{pe}	Electron diffusion coefficient in p emitter and hole diffusion coefficient in n emitter.
μ_n, μ_p	Electron and hole mobilities.
μ_i	Effective mobility in i region defined by $\frac{1}{2}(\mu_n + \mu_p)$.
n_{i0}	Equilibrium electron-hole product in i region.
h_n, h_p	Ratios of electron-hole product between respective emitter and i region.
V_i	Potential difference across i region.
V_F	Applied forward voltage.
J	Current density.
N_{SP}	p-emitter surface impurity concentration.
X_{JP}	p-emitter junction depth.
W_i	i-region thickness.

I. INTRODUCTION

THE p-i-n diode has already been studied by many authors, based either on analytical or numerical approach [1]-[3]. However, only recently specific endeavors were undertaken to reduce the diode forward-voltage drop. To the authors' knowledge, the first such analysis was published by Naito *et al.* [4]. They have shown that the forward voltage decreases when the amount of impurities per unit area on the p emitter is reduced.

In the present paper, an accurate numerical model will be employed to analyze a number of diode design parameters, which contribute to reducing the forward voltage. Careful investigation of the numerical results will lead to two possible methods. One is to increase the recombination current in the i region, while the other is to increase the diffusion current in either p or n emitter. The diode structure proposed by Naito *et al.* belongs to the latter case.

For a diode with a very thin i region, the former method will provide not only a sufficiently low forward voltage but also a short reverse recovery time, if carrier lifetime in the i region is appropriately determined.

II. NUMERICAL MODEL

Recently, the numerical device modeling technique has progressed so far that it can be applied to miscellaneous design problems. The numerical model to be discussed in the following includes a number of higher order effects such as impurity-concentration-dependent carrier lifetimes, Auger recombination, heavy doping effects, degeneracy effects as described by Fermi statistics, carrier-to-carrier scattering, and carrier-to-impurity scattering [5], [6]. Impurity-dependent electron and hole lifetimes τ_n and τ_p are included by the following expressions [6]:

$$\frac{1}{\tau_n} = \frac{1}{\tau_p} = \frac{1}{\tau_i} + \frac{1}{\tau} \tag{1}$$

$$\tau_i = 3.0 \times 10^{-6}\ \mathrm{s}\, \frac{1 \times 10^{18}}{N_A + N_D}. \tag{2}$$

Every symbol frequently used in the present paper is listed in the Notation section. Hereafter, τ as given in (1), will simply be referred to as the "carrier lifetime."

Fig. 1 shows a number of calculated current-voltage (I-V) characteristics for a p-i-n diode under various hypothetical conditions. Curve 1 shows the results obtained from the present model including all effects mentioned above. Curve 2 shows the result without heavy doping effects. Curve 3 shows the result without carrier-to-carrier scattering and Auger recombination. As was predicted by Overstraeten *et al.* [7], the inclusion of heavy doping effects causes an increase in the p-n product in heavily doped regions, so that the diode saturation current increases and the forward voltage decreases. On the contrary, carrier-to-carrier scattering and Auger recom-

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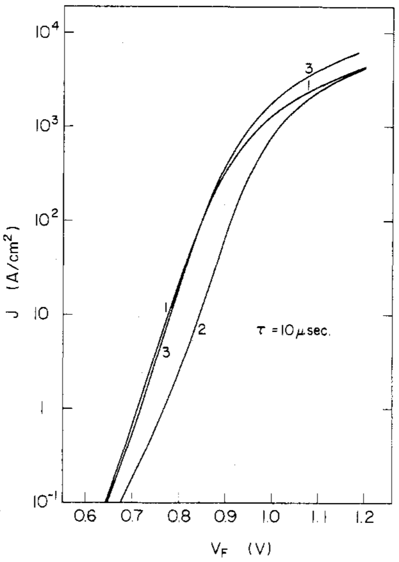

Fig. 1. Effects of heavy doping, carrier to carrier scattering, and Auger recombination. 1: Normal case (all effects included); 2: without heavy doping effects based on Fermi statistics; 3: without C-C scattering and Auger recombination.

bination increase the forward voltage at a high current-density level above ~100 A/cm², through a decrease in carrier mobility or an increase in carrier recombination.

The impurity-concentration-dependent carrier lifetime influences the forward voltage similarly to heavy doping effects. The reason for this will be clarified in the following sections. For further description of the employed model, readers are referred to a number of previous papers on device modeling [6], [8], [9].

III. Considerations for Achieving a Low Forward Voltage

A. i-Region Thickness and Carrier Lifetime

Fig. 2 shows a number of doping profiles. Curves 1 and 2 which correspond to 17- and 10-μm i-region thickness, respectively, represent typical profiles to be analyzed in this section. Curves 3 to 5 will be analyzed in the next section.

Carrier lifetime dependence of the calculated I-V characteristics for profile 1 are shown in Fig. 3. Experimental results for three samples under different gold diffusion conditions are simultaneously given to show validity of the model. As for Fig. 3, for carrier lifetime above 35 ns, the forward voltage at 150 A/cm² generally decreases with a decrease in carrier lifetime. On the contrary, for a carrier lifetime below 10 ns, the forward voltage begins to increase drastically with a decrease in carrier lifetime. Fig. 4 shows the forward voltage at 150 A/cm² versus the i-region thickness W_i characteristics with carrier lifetime as a parameter. The forward voltage for a constant carrier lifetime tends to increase with the increase in W_i for the calculated W_i range. As the carrier lifetime decreases, the forward voltage increases more rapidly, accompanying an increase in W_i. Thus there exists a characteristic carrier lifetime that minimizes the forward voltage for a given i-region thickness.

Fig. 5 demonstrates the calculated electron and hole distri-

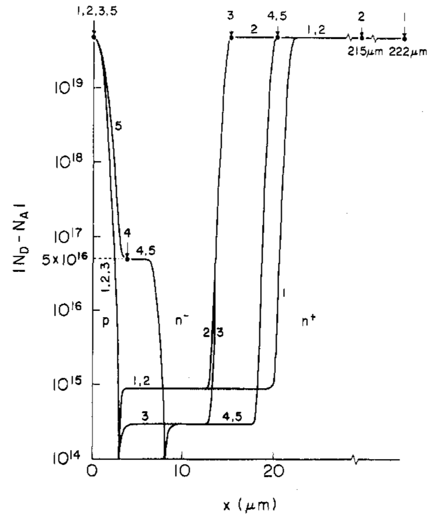

Fig. 1. Effects of heavy doping, carrier to carrier scattering, and Auger show both ends of each profile.

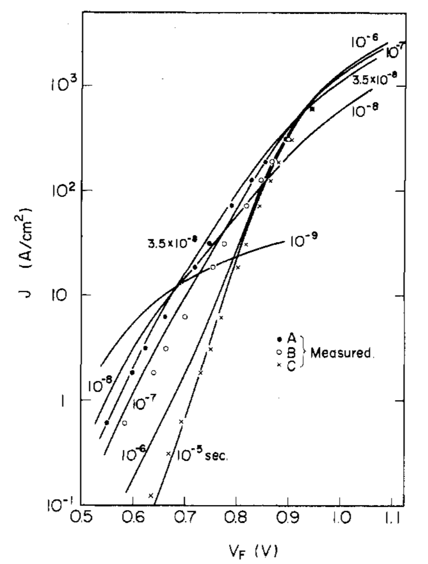

Fig. 3. Calculated I-V curves for profile 1 with carrier lifetime as a parameter.

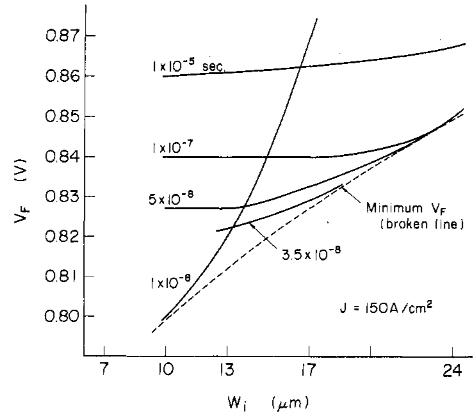

Fig. 4. Forward voltage versus i-region width characteristics with carrier lifetime as a parameter.

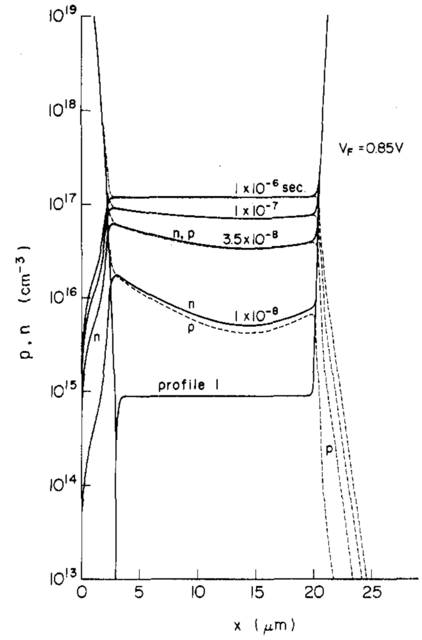

Fig. 5. Calculated electron and hole distributions for profile 1.

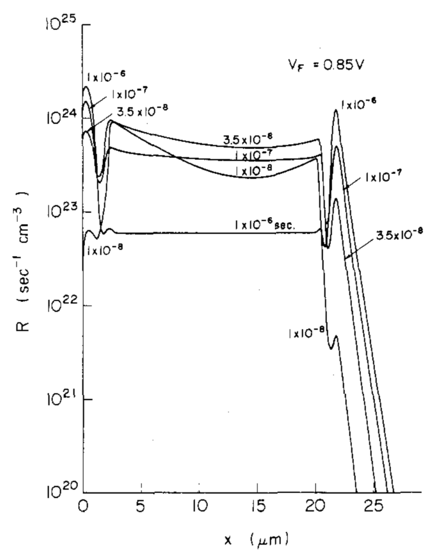

Fig. 6. Calculated recombination rate for profile 1.

butions in the diode of profile 1, whose I-V curves are given in Fig. 3. Electron and hole densities are almost equal in the i region, to form a space-charge neutral zone spreading over the i region. For a curve corresponding to $\tau = 10$ ns, electron and hole densities are different from each other, but space-charge neutrality holds, because the difference is almost equal to the net doping density. Below τ of 35 ns, electron and hole densities decrease drastically with the decrease in carrier lifetime. Fig. 6 shows the calculated recombination rate in the diode. For τ of more than 1 μs, most recombination occurs within both emitters, whereas, for τ of less than 0.1 μs, most recombination occurs within the i region. The amount of recombination within the i region increases with the decrease in carrier lifetime for τ of more than 35 ns. On the contrary, it begins to decrease below τ of 35 ns, corresponding to the drastic decrease in free carriers in the i region. The minimum forward voltage at $\tau \cong 35$ ns is brought about by the high recombination in the i region.

In the following paragraphs, simple expressions will be derived to interpret the above τ and W_i dependences on diode I-V curves, simply assuming uniform impurity doping for each of the three p-i-n layers.

According to a standard regional approach, current in both emitter regions flows by diffusion rather than by drift unless the current density is extremely high. As a result, the minority-carrier currents J_{pe} and J_{ne} are given by the following familiar expressions:

$$J_{pe} = q\sqrt{\frac{D_{pe}}{\tau_{pe}}}\,p_0, \quad \text{in n emitter} \tag{3}$$

$$J_{ne} = q\sqrt{\frac{D_{ne}}{\tau_{ne}}}\,n_0, \quad \text{in p emitter} \tag{4}$$

where p_0 and n_0 are the minority-carrier densities at the respective emitter edges.

Total recombination in the i region is equal to the total change in electron or hole current density J_{pi}, J_{ni} in the i region.

$$J_{pi} = J_{ni} = q\int_0^{W_i} \frac{n(x)\,p(x) - n_{i0}^2}{\tau_n(p(x) + n_{i0}) + \tau_p(n(x) + n_{i0})}\,dx$$

$$\cong \int_0^{W_i} q\,\frac{n(x)}{2\tau}\,dx \tag{5}$$

where the origin of the x axis is located at the p-i junction and $X = W_i$ is at the i-n junction. The ratio n_{i0}/n is considered to be negligibly small, and the neutrality condition $n(x) \cong p(x)$ is assumed. Auger recombination can be shown to be neglected for a small carrier lifetime case below 1 μs and for not extremely high current density levels below a few hundred amperes [5]. As shown in the Appendix, the following equation holds:

$$n(0)\cdot n(W_i) = n_{i0}^2 \exp\frac{q}{kT}(V_F - V_i) \tag{6}$$

where $n(0)$ and $n(W_i)$ denote carrier densities at the p-i junction and i-n junction, respectively, and V_i denotes the potential difference across the i region. p_0 and n_0 are related to $n(0)$ and $n(W_i)$, as shown in the following expressions:

$$p_0 = \frac{n^2(W_i)}{\Gamma_n}\cdot h_n^2 \tag{7}$$

$$n_0 = \frac{n^2(0)}{\Gamma_p}\cdot h_p^2 \tag{8}$$

where Γ_n and Γ_p denote impurity concentration at respective emitters, and h_p and h_n denote the ratios of the p-n products between the respective emitter and the i region. Heavy doping effects are taken into account by the h factors.

In order to obtain a simple expression for V_i, the following approximation will be introduced:

$n(x) \cong$ constant (throughout the i region).

As is understood from Fig. 5, this approximation holds if carrier lifetime is long (ambipolar diffusion length $L \gtrsim W_i/2$) and both the geometrical asymmetry of the p and n emitters and the asymmetry of carrier lifetime in the p and n emitters are insignificant. Under the above approximation, the total current $J_{pe} + J_{ni} + J_{ne}$ is carried by the drift in the i region. In this case, the following expression holds:

$$J_{pe} + J_{ni} + J_{ne} \cong q(\mu_n + \mu_p)\, n\, E_i \tag{9}$$

where E_i is the electric field in the i region. Therefore, the voltage drop V_i is given by

$$V_i = E_i W_i = \frac{W_i}{\mu_n + \mu_p}\left(\sqrt{\frac{D_{pe}}{\tau_{pe}}}\frac{h_n^2}{\Gamma_n}n + \sqrt{\frac{D_{ne}}{\tau_{ne}}}\frac{h_p^2}{\Gamma_p}n + \frac{W_i}{2\tau}\right). \tag{10}$$

The first two terms in (10) will be neglected, compared with the last term for the not extremely high current density level and the small carrier lifetime case. For such a numerical example, $\mu_n + \mu_p \sim 1100$ cm^2/V · s, $\Gamma_n = \Gamma_p \sim 5 \times 10^{19}$, $n \sim 10^{17}$, $D_{pe} \sim D_{ne} \sim 1.5$ cm^2/s, $h_n^2 \sim h_p^2 \sim 20$, $\tau_{pe} \sim \tau_{ne} \sim 38$ ns, $W_i \sim 17$ μm, and $\tau \sim 0.1$ μs will be substituted into (10). For a very thin W_i case, this abbreviation can be valid regardless of the carrier lifetime value, because the first two terms' contribution to V_i, themselves, is small.

Finally, for the case of interest, the total current density J is given as follows:

$$J = q\left(\sqrt{\frac{D_{ne}}{\tau_{ne}}}\frac{h_p^2}{\Gamma_p} + \sqrt{\frac{D_{pe}}{\tau_{pe}}}\frac{h_n^2}{\Gamma_n}\right)n^2 + q\frac{W_i}{2\tau}n \tag{11}$$

$$n = n_{i0}\exp\frac{q}{2kT}\left(V_F - \frac{W_i^2}{4\mu_i\tau}\right) \tag{12}$$

$$\mu_i = \tfrac{1}{2}(\mu_p + \mu_n). \tag{13}$$

The first term in (11) is a "diffusion current" term while the second is a "recombination current" term. As τ decreases, the recombination term for constant voltage V_F generally increases, according to the component $1/\tau$, and reaches a maximum at

$$\tau_0 = \left(\frac{q}{kT}\right)\frac{W_i^2}{8\mu_i}. \tag{14}$$

Below this value, it decreases exponentially accompanying the decrease in n. On the contrary, the diffusion term for constant voltage V_F almost always decreases with a decrease in τ, because τ_{ne} and τ_{pe} are determined by the high impurity density in the respective emitters in (1) for relatively high τ values.

Equation (11) can be rewritten as a function of W_i^2/τ and $1/W_i$

$$J = \left(\frac{A}{\sqrt{\tau_{ne}}} + \frac{A'}{\sqrt{\tau_{pe}}}\right)\left[n\left(\frac{W_i^2}{\tau}\right)\right]^2 + \frac{q}{2}\frac{1}{W_i}\cdot\frac{W_i^2}{\tau}\cdot n\left(\frac{W_i^2}{\tau}\right). \tag{15}$$

Generally, the latter recombination term is dominant when the carrier density n and the current density are small. In the following, let the W_i^2/τ value be kept constant for simplicity of analysis. For a diode with a sufficiently narrow W_i, the recombination current is dominant, even for high current density levels, because it changes proportionally to $1/W_i$. Thus the total current for a constant voltage reaches its maximum at $W_i^2/\tau_0 = 8\mu_i kT/q$, where the recombination current takes its maximum. In other words, the forward voltage for a constant current takes its minimum at $W_i^2/\tau_0 = 8\mu_i kT/q$.

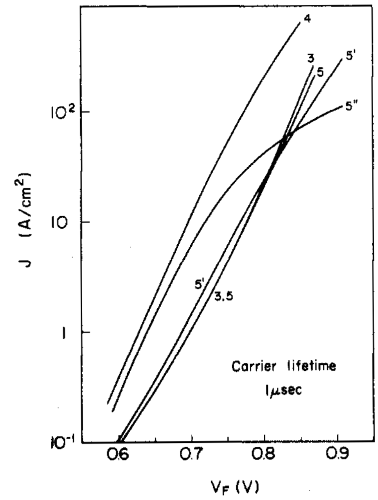

Fig. 7. Calculated I-V curves.

To confirm the prescribed assumption of $L \gtrsim W_i/2$, the ambipolar diffusion constant D is calculated to be

$$D = \frac{kT}{q}\cdot\frac{2\mu_n\mu_p}{\mu_n + \mu_p} \sim \frac{kT}{q}\mu_i.$$

This yields, together with (14),

$$L = \sqrt{D \cdot 2\tau} \sim \sqrt{2\frac{kT}{q}\mu_i\tau_0} = \frac{W_i}{2}.$$

B. p-Emitter Condition

Initially, the surface impurity concentration N_{sp} and the junction depth X_{JP} will be investigated. Curve 4 in Fig. 7 shows the calculated I-V curve for profile 4, whose N_{sp} is as low as 5×10^{16}. In Fig. 7, the carrier lifetime τ is kept constant at 1 μs. The forward voltage is seen to be low, as compared with curve 3 corresponding to profile 3 with the N_{sp} value as high as 5×10^{19}. Generally, however, a good ohmic contact cannot be formed on a low surface concentration layer, so that a low N_{sp} will not actually provide a low forward voltage.

For profile 5, a high-impurity layer is additively laid on the surface of profile 4 to enable realizing a good ohmic contact. The corresponding calculated result 5 in Fig. 7 is found to be hardly different from curve 3. Curve 5$'$ shows the result for a profile being ten times as long as profile 5 in the low concentration emitter layer. Curve 5$''$ shows the result for the same profile, but with carrier lifetime being modified to be as low as 10 ns in the low concentration emitter layer, and kept at the original value of 1 μs for the remaining region. In this case, a low forward voltage can be obtained at low current-density levels below 100 A/cm^2. However, for above 100-A/cm^2 current density, the voltage drop across the low concentration emitter

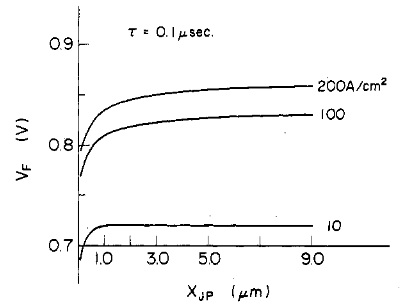

Fig. 8. Forward voltage versus p-emitter width characteristics.

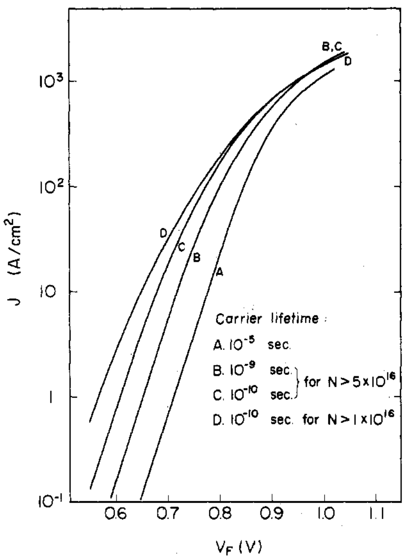

Fig. 9. Calculated I-V curves for profile 1 with extremely low p-emitter carrier lifetime. N denotes $|N_D - N_A|$.

layer becomes significantly large, because conductivity modulation hardly occurs there. It can thus be concluded that a low-concentration emitter itself will be invalid for realizing a low forward voltage, unless a good ohmic contact is formed on the low impurity concentration surface.

Fig. 8 shows forward voltage versus junction depth X_{JP} characteristics for a 0.1-μs carrier lifetime, with other design parameters being identical to those for profile 1.

As X_{JP} decreases below 3 μm, the forward voltage gradually decreases. For X_{JP} below 0.5 μm, the forward voltage begins to decrease drastically.

In the above two cases, it was found that a low forward voltage is realized by an enhanced diffusion current in the p emitter. In a low N_{sp} diode, a large diffusion current is caused by a large amount of minority carriers in the emitter. In the thin emitter case, it is brought about by a steep minority-carrier gradient. It should be understood that the most essential point is to increase the diffusion current in one of the emitters, especially the p emitter. Thus the best way to increase the diffusion current will probably be to decrease the carrier lifetime only for a high impurity concentration portion of the p emitter. Fig. 9 shows a number of calculated results for profile 1 with the carrier lifetime being significantly decreased only for the high concentration p-emitter portion ($|N_D - N_A| >$ 10^{16} or 5×10^{16}). This method makes it possible to decrease the forward voltage of a diode with a high surface impurity concentration and a properly thick p-emitter layer.

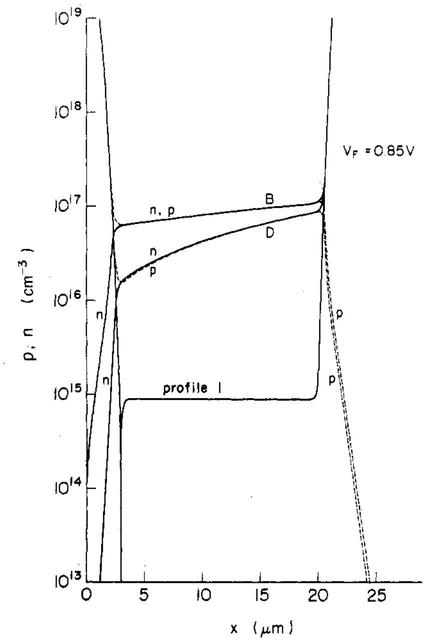

Fig. 10. Calculated electron and hole distributions for profile 1 with extremely low p-emitter carrier lifetime.

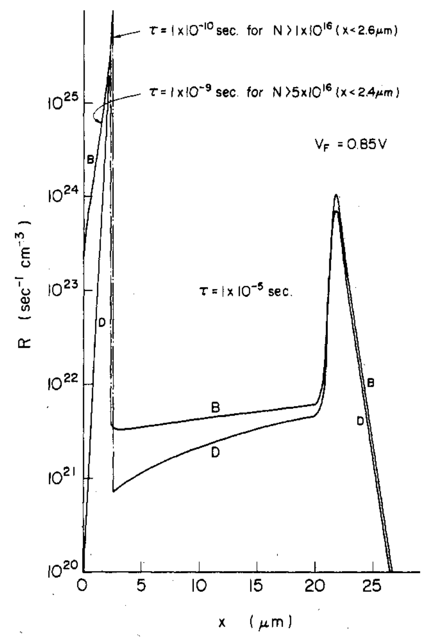

Fig. 11. Calculated recombination rate for profile 1 with extremely low p-emitter carrier lifetime.

Figs. 10 and 11 show free carrier distributions and the recombination rate, respectively, inside the above diode. As most of the recombination occurs in the p emitter, the current in the i region is carried mostly by electrons. An analytical study on the assumption of the entire neglect of hole current in the i region has been given in [4]. In this ideal case, the forward voltage always decreases with a decrease in the carrier lifetime in the p-emitter high impurity concentration layer.

On the contrary, if carrier lifetimes in both emitters are decreased so as to increase the diffusion currents in both emitters, it is easily shown, in a way similar to that in Section III-A, that excessive lifetime reduction causes a high forward voltage at high current density levels. Generally, an increase in diffusion current provides a lower forward voltage at higher current density levels than the method described in Section III-A, because the diffusion current has an $\exp(q/kT) \cdot V_F\ V_F$ dependence, whereas the recombination current has an $\exp(q/2kT) \cdot V_F\ V_F$ dependence.

IV. Experimental Results

High reverse voltage and short reverse recovery time are both important diode characteristics to be considered in addition to low forward voltage.

For a very thin i-region diode, it is the most efficient method for simultaneously reducing forward voltage and reverse recovery time to decrease carrier lifetime throughout the diode and increase the recombination current, because appropriate carrier lifetime, given by $\tau_0 = (q/kT)\ W_i^2/8\mu_i$, is of a several tens of nanosecond order. Increasing only the electron diffusion current will be the best method for decreasing the forward voltage, but it gives only a little improvement in reverse recovery time because of high i-region carrier lifetime. In addition, for a diode with appropriate i-region thickness W_i, such as 17 μm, increasing the recombination current decreases the forward voltage at 150 A/cm^2 sufficiently low, compared with the method of increasing electron diffusion current. The following experiments were, therefore, carried out adopting the former method. There are two important points in achieving a low forward voltage diode by the former method. One is to realize the thinnest possible i region, while keeping high reverse voltage. The other is to determine the most preferable lifetime killing doping condition in order to realize the i-region lifetime given by $\tau = (q/kT)(W_i^2/8\mu_i)$. Accurate numerical results will be very helpful to determine the condition.

Manufacturing processes are as follows. First, a 15-$\Omega \cdot$ cm and 20-μm-thick phosphorus-doped epitaxial layer is formed on 0.001-$\Omega \cdot$ cm As-doped substrate. p-type dopant, such as boron, and lifetime killer are subsequently diffused to form 3-5-μm-thick p$^+$ layer with high N_{SP} and to decrease carrier lifetime. Three metal layers V-Ni-Au are evaporated on both surfaces to form ohmic contacts. Then, selective etching is performed to make a mesa structure. Finally, junction passivation and assembly processes are carried out in the usual way.

Fig. 12 shows experimentally obtained characteristics on reverse recovery time and forward voltage versus gold diffusion condition for diodes with 17-μm i region and 3-μm p emitter. In this case, the gold diffusion condition of 965°C for 100 min realizes the optimized carrier lifetime τ, which is estimated as 30 ns from $(q/kT)(W_i^2/8\mu_i)$, and realizes reverse recovery time of 50 ns and minimum forward voltage of 0.83 V (150 A/cm^2), which is in close agreement with calculated results shown in Fig. 4. The main characteristics of the obtained diodes are listed in Table I.

V. Conclusion

Through accurate numerical analysis, it was found that, for a thin i-region diode, achieving appropriate carrier lifetime in

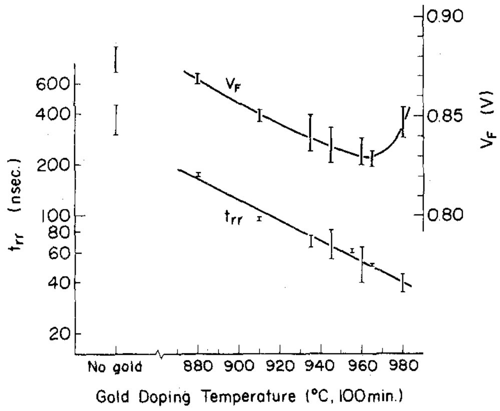

Fig. 12. Forward voltage and reverse recovery time versus gold-diffusion condition characteristics for the fabricated diodes.

TABLE I

Reverse voltage		200^V
Forward average current		30^A
Forward voltage (30^A, 150^A/cm^2)		
	at 25°C	0.83^V
	at 150°C	0.66^V
Reverse recovery time		50 nsec
1 cycle surge current capability		600^A

the i region is one of the simplest and most effective methods to realize not only a low forward voltage but also a short reverse recovery time.

The most important point for this method is to optimize the i-region width W_i and the carrier lifetime τ so that the relation $W_i^2/\tau = 8\mu_i kT/q$ holds. Another applicable method is to decrease the carrier lifetime only for the p-emitter high impurity concentration region and to keep it sufficiently high for the other regions. This method will give a lower forward voltage than the above mentioned method, but is less effective for decreasing the reverse recovery time.

On the basis of the former method, diodes with a 0.83-V forward voltage at 150 A/cm^2, a 200-V reverse voltage, and a 50-ns reverse recovery time were obtained.

Appendix

Interest is confined to the case in which high injection condition holds for the i region and low injection condition for both emitters. This is equivalent to the condition Γ_n and $\Gamma_p \gg n \gg \Gamma_i$, where Γ_i denotes the i-region impurity concentration. In the i region, the following equations hold from the neutrality condition $n \cong p$:

$$\phi_p(0) - \psi(0) = \psi(0) - \phi_n(0) \tag{A1}$$

$$\phi_p(w_i) - \psi(w_i) = \psi(w_i) - \phi_n(w_i) \tag{A2}$$

where $\phi_n\,\phi_p$ and ψ denote electron and hole quasi-Fermi levels and electrostatic potential, respectively. As the emitters are at low injection level, the quasi-Fermi levels for majority carriers are considered to be constant. Thus

$$\phi_p(0) - \phi_n(w_i) = V_F. \tag{A3}$$

From (A1)-(A3), with $V_i = \psi(0) - \psi(w_i)$

$$[\psi(0) - \phi_n(0)] + [\phi_p(w_i) - \psi(w_i)] = V_F - V_i. \tag{A4}$$

Taking the exponential of (A4) yields

$$n(0) \cdot n(W_i) = n_{i0}^2 \ \exp \frac{q}{kT} (V_F - V_i). \tag{A5}$$

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Double-Injection Phenomena Under Magnetic Field in SOS Films: A New Generation of Magnetosensitive Microdevices

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***Abstract*—We analyze several sensors belonging to the magnetodiodes family and realized with silicon on sapphire (SOS) technology. They are: p^+-n-n^+, Schottky and filamentary magnetodiodes. These very simple devices have "micronic" dimensions compatible with VLSI and exhibit sensitivities which are two orders of magnitude higher than conventional sensors: 30 V/T have been measured on Schottky magnetodiodes without amplification and for low power dissipation. It is shown that the optimum operating as well as the improvement of the device design require conditions of high level injection, corresponding to double-injection phenomena: thus the establishment and the behavior of the so-called "semiconductor regime" have been systematically studied for numerous diodes with different geometries and dopings. Narrowest structures, shorter than 20 μm and with the doping below 10^{22} m^{-3} are shown to be suitable. The detailed analysis of different magnetosensitivities is completed with experiments on noise, temperature, and high magnetic field.**

I. INTRODUCTION

THE p^+-n-n^+ diodes realized with silicon on sapphire (SOS) technology have been recently proposed for the magnetic field detection [1]-[3]. Their large magnetosensitivity is based on the so-called "magnetodiode effect" [4]-[6], particularly favored in SOS: when a magnetic induction $\boldsymbol{B}$ is applied in the plane of the film, perpendicularly to the current J (Fig. 1), the electrons and holes injected by the contacts are deflected either towards the high recombining interface Si-Al_2O_3 or towards the low recombining interface Si-SiO_2; in this way the mean carrier density and then the current are reduced or enhanced. These magnetodiodes (MD) offer a wide field of applications as sensitive and low-cost devices. In comparison with the well-known Hall integrated sensors, the MD are not only compatible with the VLSI, but also exhibit magnetosensitivities much more important [1], [2], [7].

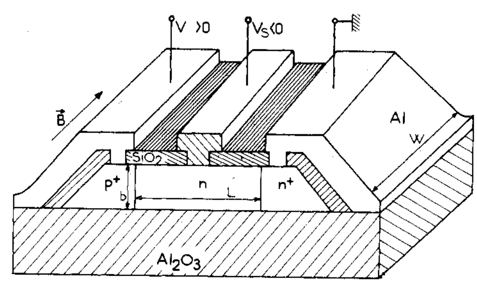

Fig. 1. Configuration of SOS p^+-n-n^+ and Schottky magnetodiodes.

We present here new results collected from a high number of devices with different dopings and dimensions. p^+-n-n^+ structures were processed on ⟨100⟩ SOS substrates (CVD de-

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