Let us carry out numerical evaluations. With $\beta_1, 2 \sim 0.1$ and $q^2/2m \sim \Omega$ we have $E^{AE}_e/E^{AE}_e \sim p^{3/2} = 0.03$, i.e., taking into account the usually large values of $E^{AE}_e$, this ratio is fully perceptible. Moreover, if the sound wave is a standing wave, $E^{AE}_o = 0$, while $E^{AE}_e$ (together with $E^{PG} = J^{PG}/\sigma_o$) are not zero and, therefore, fully determine the electric field. If $T = 100^\circ K$, $v_s = 10^5$ cm/sec, $W \sim 1$ W/cm$, q \sim 10^6$ cm$^{-1}$, then $E^{PG} = 2.5 E^{AE}_e$. Observation of the effects under consideration does not constitute a problem. For example, if both EM waves are directed normal to the specimen surface, in the penetration depth $L << c/\Omega$ (c is the velocity of light the dephasing due to the difference in the refraction indices of the two EMW will be small, and the effects mentioned should appear in a thin surface layer of the specimen (in the general case they occur when $\kappa = 2\Omega, \kappa + L$ is odd).

In conclusion let us note that generally the even AE effect should, apparently, be classified as an acoustogalvanic effect (in analogy with the class of photogalvanic effects).

LITERATURE CITED


EFFECT OF THE IMAGE FORCES ON THE VOLT-AMPERE CHARACTERISTICS
OF A METAL-α-Si CONTACT

V. V. Il'chenko and V. I. Strikha

In the paper an analytic calculation is carried out of the volt-ampere characteristics of a Schottky barrier diode on amorphous silicon for an exponential distribution of the density of localized states in the mobility gap of α-Si. Explicit expressions are written for the volt-ampere characteristics with and without the inclusion of the image forces. It is shown that taking into account the image forces in the case of an intimate contact can lead to a substantial increase in the reverse currents through the diode, at the same time changing slightly the slope of both the forward and reverse branches of the volt-ampere characteristics plotted on a semilogarithmic scale.

There has lately been increasing interest in the investigation of the rectifying properties of Schottky barrier diodes on amorphous silicon in view of the prospects of their application in solar energy and microelectronics. However, the calculations of the volt-ampere characteristics (VAC) of the metal-α-Si contact [1, 2] available in the literature, which take into account the nonuniform distribution of the space charge density in the barrier region, were carried out numerically, usually not taking into account the effect of the image forces on the VAC. In the present paper, within the framework of the diffusion theory of rectification, an analytic calculation of the VAC is proposed for an intimate metal-α-Si contact with and without the inclusion of the image forces, whose effect may, in view
of the small thickness of the space charge region (SCR), lead to a substantial increase in the currents through the contact [3].

The calculation are based on a model [4] in which the localized states in the mobility gap of α-Si are divided into donor and acceptor states charged respectively positively and negatively in the ionized state. It is assumed that the distribution in energy of the density of localized states $g_n(e)$ and $g_p(e)$ of the two types of centers can be approximated by an exponential dependence of the form $g_n(e) = B \exp[-\beta(e_g + e)]$ and $g_p(e) = A \exp[e]$, where $A, B, \alpha, \beta$ are constants determinable from the distribution $N(s)$; $\varepsilon_g$ is the width of the mobility gap in α-Si.

1. Calculation of the Field Intensity and the Profile of the Potential Barrier

Substituting the respective distributions $g_n(e)$ and $g_p(e)p(\varphi)$ in the right side of the Poisson equation

$$
\frac{d}{dx} \left[ \left( \frac{d\varphi}{dx} \right)^2 \right] = -\frac{2e}{\varepsilon_0} \rho(\varphi), \tag{1}
$$

on the assumption of a constant Fermi level in the space charge region, one can calculate the field at $x = 0$ as a function of the height of the potential barrier $\varphi_0 - eV$

$$
\left. \frac{1}{e} \frac{d\varphi}{dx} \right|_{x=0} = \left[ \frac{2e}{\varepsilon_0} \right]^{1/2} \left[ \frac{B}{\beta} \exp[-\beta(e_g + \varepsilon_f)] - \frac{A}{\alpha} \exp[\varepsilon_g - e] \right] \times
$$

$$
(\varphi_0 - eV) + \frac{B}{\beta^2} \exp[-\beta(e_g + \varepsilon_f)] \left[ \exp[\beta(\varphi_0 - eV)] - 1 \right] \frac{A}{\varepsilon_g} \exp(\varepsilon_g) \left[ 1 - \exp[-\beta(\varphi_0 - eV)] \right], \tag{2}
$$

where $\varepsilon_f$ is the position of the Fermi level in the bulk of α-Si. Estimates show that at $x = 0$ the field intensity for $\varphi_0 - eV = 0.5$ eV attains a value of the order of $\sim 10^5$ V/cm. At the same time the maximum contribution to the expression for the field comes from the second term which takes into account the charge of donor-like states. Therefore, for $0.1 < \varphi_0 - eV < 0.8$, one can neglect in (2) all the terms except the second. Whence, integrating the equation for the field, we find

$$
\varphi = -\frac{2}{\beta} \ln[1 - x(L - x)], \tag{3}
$$

where

$$
x = \frac{1}{2} \left( \frac{2e}{\varepsilon_0} \right)^{1/2} \{B \exp[-\beta(e_g + \varepsilon_f)]\}^{1/2}; \tag{4}
$$

$$
L = \left[ 1 - \exp(-\frac{\varphi_0 - eV}{2\beta}) \right]^{-1}. \tag{5}
$$

The expression obtained for the profile of the potential barrier is valid in the case of specially nondoped α-Si, when the Fermi level in the bulk lies approximately at the middle of the α-Si mobility gap ($\varepsilon_f = 0.65$ eV).

The effect of the image forces in an intimate contact with the metal leads to the lowering of the potential barrier for electrons, which is taken into account in the calculations by the introduction of an effective potential. The lowering of the barrier at the metal–α-Si contact could cause a redistribution of charge in localized states and, in its turn, entail a change in the profile of the potential barrier near the contact. However, the image forces are substantial only at short distances of the order of 3 nm from the metal electrode. In this region of the barrier the charge derives from deep levels of the quasicontinuous spectrum of localized states in α-Si whose characteristic refilling time is, according to estimates carried out in [5], considerably longer than the time necessary for an electron to cross the space charge region. This implies that the system of bond charges in localized