Analysis of current-voltage-temperature (I-V-T) and capacitance-voltage-temperature (C-V-T) characteristics of Pt/Ti Schottky contacts on n-type InP

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We have investigated the current-voltage (I-V) and capacitance-voltage (C-V) characteristics of the Pt/Ti Schottky contacts on n-type InP in the temperature range of 200-440 K. An experimental barrier height (BH) Φ_{bo} and ideality factor n values of 0.47 eV (I-V), 0.82 eV (C-V) and 3.26, and 0.74 eV (I-V), 0.73 eV (C-V) and 1.21 are obtained for the Pt/Ti/n-InP Schottky diode at 200 K and 440 K.. A decrease in the experimental BH Φ_{bo} and an increase in the ideality factor n with a decrease in temperature have been explained on the basis of a thermionic emission (TE) mechanism. This behaviour is interpreted by the assumption of Gaussian distribution of the barrier heights due to the barrier inhomogeneities that prevail at the metal-semiconductor interface. It is found that the series resistance (R_s) of Pt/Ti Schottky contacts is strongly temperature dependent. A modified $\ln(I_o/T^2)$-$q^2\sigma_o^2/2(kT)^2$ versus 1000/T plot gives mean barrier height $\overline{\Phi}_{bO}$ and Richardson constant A^* as 0.94 eV and 6.23 A/cm^{2}K^2, respectively. The Richardson constant value of 6.23 A/cm^{2}K^2 is in close agreement with the known value of 9.4 A/cm^{2}K^2 for n-type InP. The discrepancy between Schottky barrier heights (SBHs) calculated from I-V and C-V measurements is also explained. It can be concluded that the temperature dependent characteristics of the Pt/Ti/n-InP Schottky diode can be explained on the basis of thermionic emission (TE) mechanism with Gaussian distribution of the Schottky barrier heights (SBHs).

1. Introduction

Schottky barrier diodes (SBDs) have been widely investigated in terms of material and device physics, design and fabrication technology and applications for decades. The metal-semiconductor (MS) structures are of important applications in the electronics industry. The applications consist of microwave filed effect transistors, radio-frequency detectors, phototransistors, heterojunction bipolar transistors, quantum confinement devices and space solar cell [1-4]. Particularly indium phosphate (InP) being one of the III-V compound semiconductors is a promising material for high-speed electronic and optoelectronic devices due to its large direct band gap, high electron mobility, high saturation velocity and breakdown voltage which is very important in electronic devices [5,6]. The analysis of the current-voltage (I-V) characteristics of Schottky barriers on the basis of thermionic emission diffusion (TED) reveals an abnormal increase of the barrier height (BH) and decrease of the ideality factor with increasing temperature [1-10]. Also, the ideality factor has been found to increase with increasing carrier concentration, while BH obtained by the I-V measurements decrease with increasing doping level [1]. Particularly, the devices operating at cryogenic temperature such as infrared detectors, sensors in thermal

imaging, microwave diodes and nuclear particle detectors needs the Schottky barrier diodes (SBDs) with low barrier height (BH). Hence, analysis of the current-voltage (I-V) characteristics of the SBDs at room temperature only does not give detailed information about their conduction process or the nature of barrier formation at the metal/semiconductor interface [11-14]. The temperature dependence of the forward I-V characteristics allows the identification of the different conduction mechanism modes across the metal/InP interface and the study of different effects, such as barrier inhomogeneities and surface states density, on carrier transport at metal/InP Schottky barrier diodes.

Most of the experimental and theoretical studies of the current flow mechanism in Schottky barriers have been reported in the literature [15-19]. Cetin et al [15] studied the temperature dependent current-voltage (I-V) and capacitance-voltage (C-V) characteristics of the Au/n-InP Schottky barrier diodes in the temperature range of 80-320 K. They showed that the ideality factor and the BHs determined from the forward I-V characteristics are found to be strong functions of temperature. Soylu et al [16] investigated the electrical characteristics of the gold (Au) Schottky contacts on moderately doped n-InP (Au/MD n-InP) in the temperature range of 60-300 K. They reported that the ideality factor n of the diode decreases while the

corresponding zero-bias SBH increasing with an increase in the temperature. Cimilli et al [17] investigated the temperature dependent electrical characteristics of Ag Schottky contacts on n-InP in the temperature range of 30-320K. They reported that the decrease in the experimental barrier height calculated from I-V measurement and an increase in the ideality factor with a decrease in the temperature is due to the barrier inhomogeneities at the metal-semiconductor interface. Naik et al [18] investigated the temperature dependent current-voltage (I-V) and capacitance-voltage (C-V) characteristics of the Au/Ni/n-InP SBDs in the temperature range of 210-420 K. They showed that the decrease in ideality factor and increase in BH with increasing temperature. Recently, Nanda Kumar Reddy et al [19] fabricated Pt/Au/n-InP Schottky barrier diode and investigated current-voltage (I-V) and capacitance-voltage (C-V) in the temperature range of 210-420 K in steps of 30 K. They showed that the barrier parameters vary significantly with temperature.

Many attempts have been made in order to understand the current conduction of the Schottky barrier diode (SBDs). The main aim of this work is to fabricate and investigate the current-voltage (I-V) and capacitance-voltage (C-V) characteristics of Pt/Ti Schottky contacts on n-type InP in the temperature range of 200-440 K. In the present work, titanium (Ti) is chosen as the first layer because it has low work function as well as to provide the lowest forward voltage drop. Platinum (Pt) is selected as the second layer because it has high work function, high reliability and high reactivity with InP. The resultant temperature dependent barrier characteristics of the Pt/Ti/n-InP Schottky barrier diodes were interpreted on the basis of the existence of Gaussian distribution of the barrier height.

2. Experimental

The Schottky barrier diodes are fabricated on using n-type InP wafer with carrier concentration of $4.9\text{-}5\times10^{15}$ cm^{-3}. The wafer is sequentially cleaned with trichloroethylene, acetone and methanol for 5 min each by means of ultrasonic agitation and then rinsed in deionized (DI) water. The wafer is then dried in high-purity N_2 gas. The cleaning procedure is followed by a 1 min dip in HF:H_2O (1:10) solution to remove the native oxide from the front surface of the substrate. Low-resistance ohmic contact on the back side of the wafer is formed by evaporation of indium at a pressure of 6×10^{-6} mbar with a thickness of 50 nm, followed by thermally annealing at 350 °C for 1 min in N_2 ambient. The Schottky metals Ti (20 nm)/Pt (30 nm) are evaporated through a stainless steel mask having diameter of 1 mm by electron beam evaporation system at 5×10^{-6} mbar pressure. Metal layer thickness as well as deposition rates are monitored with the help of a digital quartz crystal thickness monitor. The deposition rates were about 0.2 to 1 Å/s. The current-voltage (I-V) and capacitance-voltage (C-V) characteristics of the Pt/Ti/n-InP Schottky barrier diodes are made using a Keithley 2400 and DLS-83D spectrometer in the temperature range of 220-440 K and in

dark. The device temperature is controlled with an accuracy of ± 1K by using temperature controller DLS-83D-1 cryostat.

3. Results and discussion

3.1 Current-voltage (I-V) characteristics of Pt/Ti Schottky contacts as a function of temperature

The forward and reverse bias current-voltage (I-V) characteristics of Pt/Ti/n-InP Schottky barrier diodes (SBDs) in the temperature range of 200-440 K are shown in Fig. 1. According to thermionic emission theory, the current-voltage (I-V) relationship for Schottky barrier diodes is give by the expression [20].
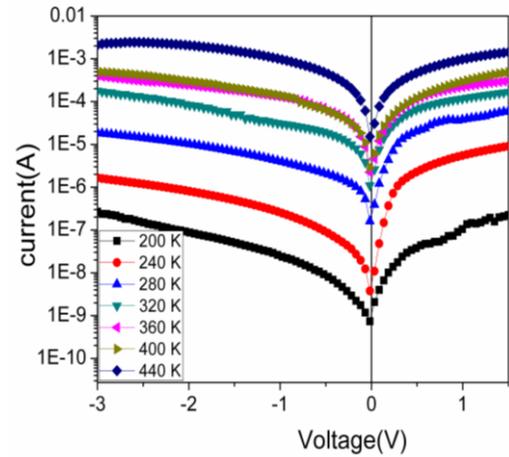

Fig. 1. Experimental reverse and forward-bias current-voltage (I-V) characteristics of Pt/Ti/n-InP Schottky diode in the temperature range of 200-440 K.

$$I = I_O \exp\left(\frac{q(V - IR_S)}{nkT}\right)\left[1 - \exp\left(\frac{-q(V - IR_S)}{kT}\right)\right] \quad (1)$$

where V is the applied voltage, the term IR_s is the voltage drop across the R_s of the diode, n is an ideality factor, T is the absolute temperature, k is the Boltzmann constant, q is the electronic charge and I_o is the reverse saturation current and it can be expressed as

$$I_O = AA^*T^2 \exp\left(\frac{-q\Phi_{bo}}{kT}\right) \quad (2)$$

where Φ_{bo} is the zero-bias barrier height, A is the diode area, A^* is the effective Richardson constant and equal to 9.4 Acm^{-2}k^{-2} for n-type InP [21]. From Eq. (1), ideality factor n can be written as

$$n = \frac{q}{kT}\left(\frac{dV}{d\ln I}\right) \quad (3)$$

The ideality factor n is introduced to take into account the deviations of the experimental I-V data from the ideal thermionic model and should be n=1 of an ideal contact.

The experimental values of Φ_{bo} and n are determined from intercepts and slopes of the forward-bias ln(I) versus V plot at each temperature, respectively. The experimental values of Φ_{bo} and n for the Pt/Ti/n-InP SBD range from 0.74 eV and 1.21 (at 440 K) to 0.47 eV and 3.26 (at 200 K), respectively. The obtained values of n and Φ_{bo} are plotted as a function of temperature in Fig. 2. It is clearly observed that the ideality factor n exhibits an increasing trend with decreasing temperature, whereas the zero-bias barrier height Φ_{bo} decreases with decrease in temperature. Since the current transport across the metal-semiconductor (MS) interface is a temperature-activated process [22-26] electrons at low temperatures are able to surmount the lower barriers. Therefore, the current transport will be dominated by the current flowing through the patches of lower Schottky barrier height, leading to a larger ideality factor. In other words, more and more electrons have sufficient energy to overcome the higher barrier build up with increasing temperature and bias voltage. An apparent increase in the ideality factor and a decrease in the BH at low temperatures are caused possibly by other effects such as non-uniform thickness and the interfacial charges. The high values of ideality factor, n, are probably due to potential drop in the interfacial layer and presence of excess current and the recombination current through the interfacial states between the semiconductor/insulator layers [27].
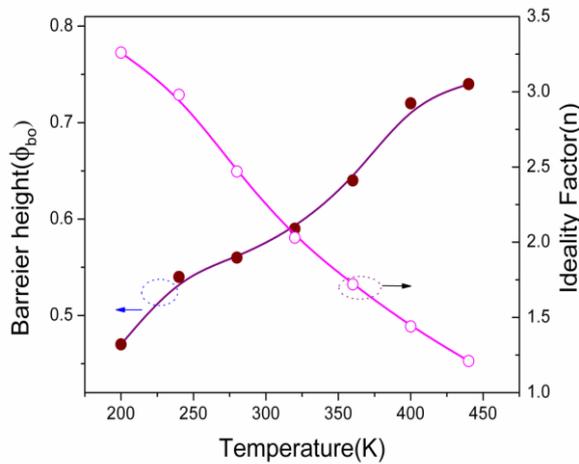

Fig. 2. Temperature dependence of the ideality factor and barrier height for Pt/Ti/n-InP Schottky diode.

The barrier height can be determined in another way by rewritten Eq. (2) as

$$\ln\left(\frac{I_o}{T^2}\right) = \ln(AA^*) - \frac{q\Phi_{bo}}{kT} \qquad (4)$$

The Richardson constant is usually obtained from the intercept of ln(Io/T2) versus 1000/T plot. Fig. 3 shows the conventional energy variation of ln(Io/T2) against 1000/T. The dependence of ln(Io/T2) versus 1000/T is found to be non-linear in the temperature range measured. The non-

linearity of the conventional ln(Io/T2) versus 1000/T is caused by the barrier height and ideality factor. Similar results have also been found by several authors [15-19]. The experimental data are seen to fit asymptotically to a straight line at higher temperatures only. An activation energy value of 0.54 eV from the slope of this straight line is obtained for the device. The value of A* obtained from the intercept of the straight portion of the ordinate is equal to $5.45 \times 10\text{-}2$ Acm-2K-2, which is lower than the known value of 9.4 $Acm^{-2}K^{-2}$ for InP. The deviation of the Richardson plots may be due to the spatially inhomogeneous barrier height and potential fluctuations at the interface that consists of low and high barrier areas [28]. Horvath [29] explained that the A* value obtained from the temperature dependence of the I-V characteristics may be affected by lateral inhomogeneity of the barrier.
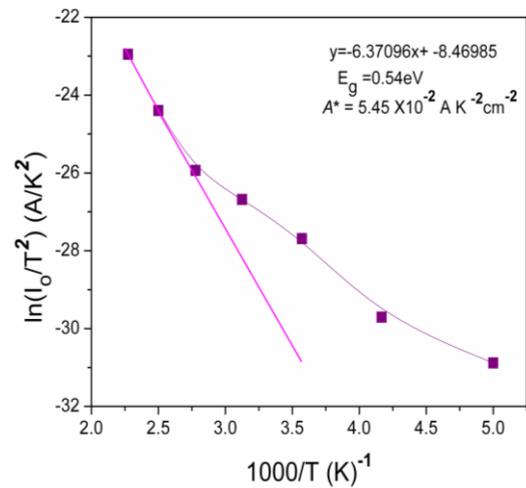

Fig. 3. Richardson plot for ln(Io/T²) versus 1000/T for Pt/Ti/n-InP Schottky diode.

The series resistance is a very important parameter of Schottky diode. The resistance of the Schottky diode is the sum total resistance value of the resistors in series and resistance in semiconductor device in the direction of current flow. As shown in Fig. 1, current-voltage characteristics of the Pt/Ti/n-InP Schottky contact show rectification behaviour. The series resistances are achieved using a method developed by Cheung [30] in the downward curvature (non-linear region) of the forward bias I-V characteristics. According to this method from Eq. (1), the related equations can be written as follows

$$\frac{dV}{d\ln(I)} = IR_s + \left(\frac{nkT}{q}\right) \qquad (5)$$

$$H(I) = V - \left(\frac{nkT}{q}\right)\ln\left(\frac{I}{AA^*T^2}\right) \qquad (6)$$
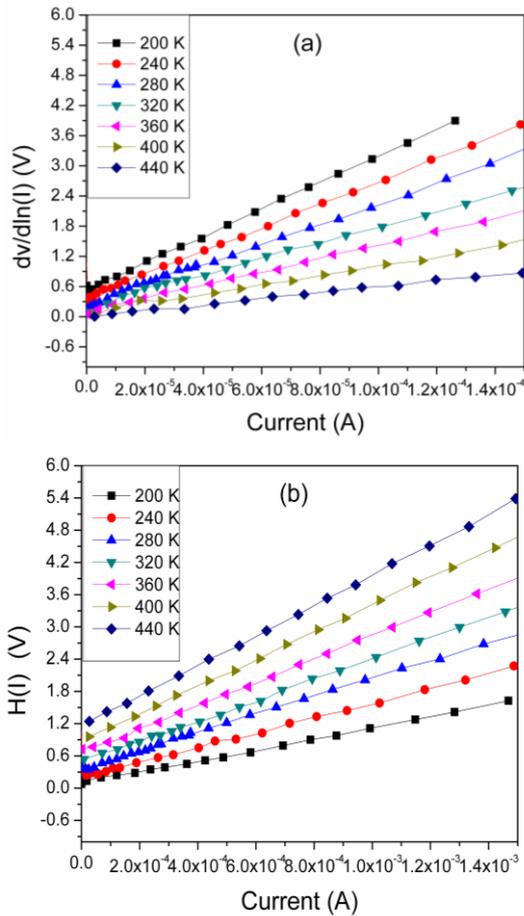
$$H(I) = IR_s + n\Phi_b \qquad (7)$$

Fig. 4. (a) Plots of dV/dln(I) versus I, and (b) H(I) versus
I for Pt/Ti/n-InP Schottky diode.

The plots of I versus dV/d(lnI) and I versus H(I) are shown in Fig. 4(a) and (b) as a function of temperature for Pt/Ti/n-InP Schottky contacts. As can be seen from these figures, Eqs. (5) and (7) give a straight line for the data of

downward curvature region in the forward bias ln I-V characteristics. Thus, a plot of dV/d(lnI) versus I will give Rs as the slope and (nkT/q) as the y-axis intercept. A plot of H(I) versus I will also give a straight line with y-axis intercept equal to nΦb. The slope of this plot also provides a second determination of Rs, which can be used to check the consistency of this approach. The experimental series resistance values from the semi-log forward bias I-V characteristics (Fig. 5) as a function of temperature. As can be seen in Fig. 5, the Rs calculated from the Cheung function shows the increase of Rs with the fall of temperature is believed to result due to factors responsible for increase of ideality factor and lack of fee carrier concentration at low temperatures [31]. The values of barrier height Φb, ideality factor n and series resistance Rs of Pt/Ti Schottky contacts are given in the Table 1.
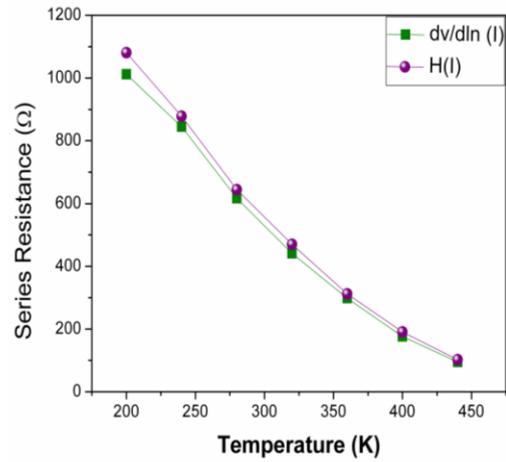

Fig. 5. Temperature dependence of the series resistances
obtained from Cheung's method for Pt/Ti/n-InP Schottky
diode.

Table 1. Ideality factors, series resistances and Schottky barrier heights of Pt/Ti Schottky contact on n-type InP in
the temperature range of 200-440 K.

T (K)	Ideality factor (n)	Series resistance (Ω)		Barrier height	
		dv/dln(I)	H(I)	Φ_{b0} (eV)	Φ_{CV} (eV)
200	3.26	1012	1081	0.47	0.82
240	2.98	845	878	0.54	0.81
280	2.47	617	644	0.56	0.80
320	2.03	441	470	0.59	0.79
360	1.72	298	312	0.65	0.77
400	1.44	176	191	0.72	0.75
440	1.21	95	102	0.74	0.73

3.2 The analysis of inhomogeneous barrier

In order to describe the abnormal behaviour of current-voltage (I-V) characteristics of a Schottky barrier

diode, an analytical potential function model using different types of barrier distribution functions at the interface on spatially inhomogeneities Schottky barrier diodes. A spatial distribution of barrier height at metal-

semiconductor interface of Schottky contacts by Gaussian distribution $P(\Phi_{bo})$ with standard deviation (σ_o) around a mean barrier height ($\overline{\Phi}_{bO}$) value has been suggested by Werner and Guttler [3]

$$P(\Phi_{bo}) = \frac{1}{\sigma_O \sqrt{2\pi}} \exp\left[-\frac{(\Phi_{bo} - \overline{\Phi}_{bo})^2}{2\sigma_O^2}\right] \qquad (8)$$

where $\dfrac{1}{\sigma_o \sqrt{2\pi}}$ is the normalizing constant.

The total current across a Schottky diode containing inhomogeneities can be expressed as

$$I(V) = \int\limits_{-\infty}^{+\infty} I(\Phi_{bo}, V) P(\Phi_{bo}) d\Phi \qquad (9)$$

where $I(\Phi_b, V)$ is the current for a barrier height Φ_{bo} at voltage V based on the ideal thermionic theory and $P(\Phi_{bo})$ is the normalized distribution function giving the probability of the occurrence of Φ_{bo}. By introducing $I(\Phi_{bo}, V)$ and $P(\Phi_{bo})$ from Eqs (1) and (8) in (9), the current of the Schottky diode with the modified barrier will be

$$I(V) = AA^*T^2 \exp\left[-\frac{q}{kT}\left(\overline{\Phi}_{bo} - \frac{q\sigma_O^2}{2kT}\right)\right] \exp\left(\frac{qV}{n_{ap}kT}\right)\left[1 - \exp\left(-\frac{qV}{kT}\right)\right] \qquad (10)$$

with

$$I_O = AA^*T^2 \exp\left(-\frac{q\phi_{ap}}{kT}\right) \qquad (11)$$

where n_{ap} and Φ_{ap} are the apparent ideality factor and apparent barrier height, respectively, and Φ_{ap} given by

$$\Phi_{ap} = \overline{\Phi}_{bo}(T=0) - \frac{q\sigma_O^2}{2kT} \qquad (12)$$

In an ideal case (n=1), the expression is obtained as follows

$$\left(\frac{1}{n_{ap}} - 1\right) = -\rho_2 + \frac{q\rho_3}{2kT} \qquad (13)$$

The temperature dependency of σ_o is usually small and can be neglected. However, it is assumed that the standard deviation σ_o and the mean value of the Schottky barrier height $\overline{\Phi}_b$ are the bias voltages linearly dependent on Gaussian parameters that are given by $\overline{\Phi}_b = \overline{\Phi}_{bo} + \rho_2 V$ and $\sigma_o = \sigma_o + \rho_{3V}$, ρ_3 and ρ_2 are the voltage coefficients that may depend on temperature (T) and they quantify the voltage deformation of the barrier height distribution. While $\overline{\Phi}_{bo}$ and σ_o are the mean barrier height and its standard deviation at the zero-bias (V=0) respectively. The decrease of the apparent zero-bias BH is affected by the existence of the interface inhomogeneities and this affect because more significant at low temperatures, since the Φ_{ap} depends on the distributed parameters $\overline{\Phi}_{bo}$ and σ_o, and temperature. On the other hand, the abnormal increasing ideality factor

occurs due to the variation of mean barrier height and standard deviation with bias i.e. terms involving voltage coefficients ρ_2 and ρ_3.

From Eqs (2) and (3) are given Φ_{ap} and n_{ap}, which fit the experimental data, should obey equations (12) and (13). Thus, a plot of Φ_{ap} versus 1/T (Fig. 6) should be a straight line that gives $\overline{\Phi}_{bO}$ and σ_o from the intercept and slope, respectively. As can be seen in Fig. 6, the values of $\overline{\Phi}_{bO}$=0.93 eV and σ_o =0.128 eV are obtained from the experimental Φ_{ap} versus 1/T plot and the same figure, the plot of n_{ap} versus 1/T should be a straight line that gives voltage coefficients ρ_2 and ρ_3 from the intercept and slope, respectively. The values of ρ_2 =0.24 V and ρ_3 =0.0077 V are obtained from the experimental n_{ap} versus 1/T plot. The standard deviation is a measure of the barrier homogeneity. The lower value of σ_o corresponds to more homogeneous barrier height. It is seen that the value of σ_o =0.128 eV is not small compared to the mean values of $\overline{\Phi}_{bO}$ =0.93 eV and it indicates the presence of the interface inhomogeneities.
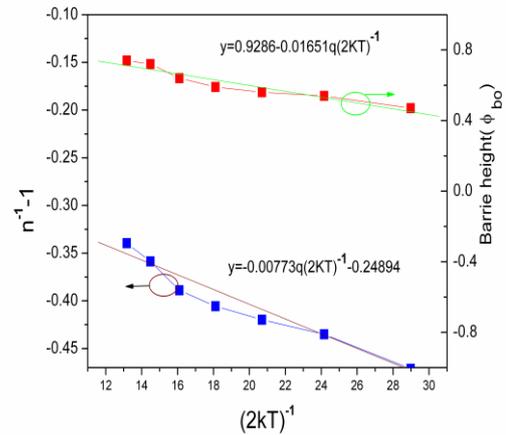

Fig. 6. The zero-bias apparent barrier height and ideality factor versus 1/2kT curves of the Pt/Ti/n-InP Schottky diode according to Gaussian distribution.

As indicated earlier, the conventional activation energy ln (Io/T2) versus 1/T plot has showed non linearity at low temperatures. To explain these discrepancies, according to the Gaussian distribution of the BH, we get

$$\ln\left(\frac{I_o}{T^2}\right) - \left(\frac{q^2\sigma_O^2}{2k^2T^2}\right) = \ln(AA^*) - \frac{q\overline{\Phi}_{bo}}{kT} \qquad (14)$$

by combining Eqs (12) and (13). A modified activation energy plot from this expression is obtained. Using the experimental I_o data, a modified $\ln(I_o/T^2) - q^2\sigma_o^2/2(kT)^2$ versus 1000/T plot according to Eq. (11) should give a straight line with the slope directly yielding the mean $\overline{\Phi}_{b0}$ and the intercept (=ln AA^*) at the ordinate determine A^* for a given diode area A. The $\ln(I_o/T^2) - q^2\sigma_o^2/2(kT)^2$ values are calculated using the value of σ_o obtained for the temperature range of 200-440 K. The best linearity fitting to these modified experimental data is depicted by solid line in Fig. 7. As shown in Fig. 7 the modified Richardson

plot of $\ln(I_o/T^2)-q^2\sigma_o^2/2(kT)^2$ versus $1000/T$ gives $\overline{\Phi}_{b0}$ =0.94 eV and A^*= 6.23 Acm^{-2}k^{-2}, respectively, without using the temperature coefficient of the barrier heights. The value $\overline{\Phi}_{b0}$=0.94 eV obtained from $\ln(I_o/T^2)-q^2\sigma_o^2/2(kT)^2$ versus $1000/T$ plot is in agreement with the value of $\overline{\Phi}_{b}o$ =0.93 eV from Φ_{bo} versus $1/T$ plot in Fig. 6.
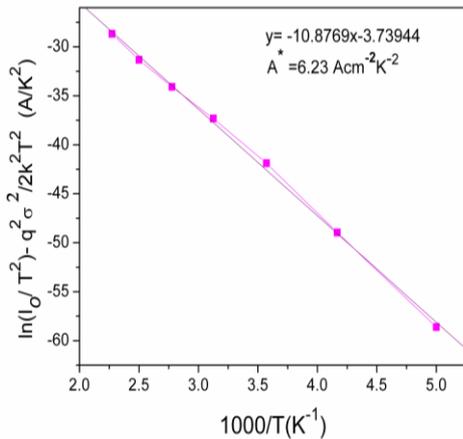

Fig. 7. Modified Richardson plot for the Pt/Ti/n-InP Schottky diode according to Gaussian distribution of the barrier heights.

3.3 Capacitance-voltage (C-V) characteristics of Pt/Ti Schottky contacts as a function of temperature

In Schottky diodes, the depletion layer capacitance is expressed as [32]

$$\frac{1}{C^2}=\frac{2\left(V_{bi}-\frac{kT}{q}-V\right)}{A^2qN_d\varepsilon_s} \qquad (15)$$

where ε_s is the permittivity of the semiconductor (ε_s =11 ε_o), V is the applied voltage and A is the surface area of the diode. The x-intercept of the plot of $(1/C^2)$ versus V gives V_o. V_o is related to V_{bi} by the equation $V_{bi}=V_o+kT/q$. the barrier height Φ_{c-v} = V_{bi} + V_n, where $V_n=(kT/q)\ln(N_c/N_d)$. The density of states in the conduction band edge is given by $N_c=2(2 \pi m^*kT/h^2)^{3/2}$, where m^*=0.078 m_o, and its value is 5.7×10^{17} cm^{-3} for InP at room temperature [21].

Fig. 8 shows the experimental reverse bias C-2-V characteristics of the Pt/Ti/n-InP Schottky barrier diodes over the temperature range 200-440 K is steps of 40 K. The junction capacitance has been measured at a frequency of 1 MHz. The temperature dependence of the experimental donor concentration (Nd) has been calculated from the slope of reverse bias C-2-V characteristics in Fig. 8. Fig. 9 shows the plot of donor concentration (Nd) against temperature. The values of Nd varied from 3.57×10^{15} to 6.1×10^{15} cm^{-3} for the Pt/Ti/n-InP Schottky diode over the temperature range between 200 and 440 K.

Measurements showed that the SBH (Φ_{cv}) values of the Pt/Ti/n-InP Schottky diodes are 0.82 at 100 K and 0.73 eV at 440 K, respectively. It can be seen from Fig. 9, the donor concentration of the n-InP decreased with decrease in temperature.
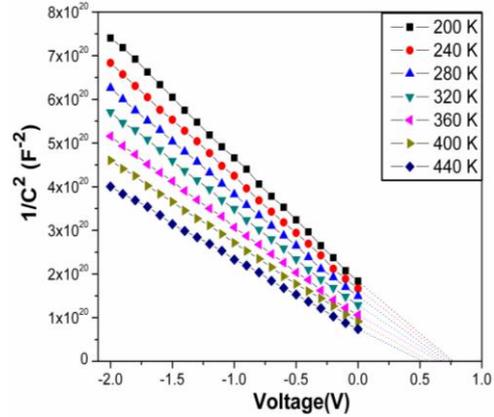

Fig. 8. The reverse bias C^{-2}-V characteristics of the Pt/Ti/n-InP Schottky diode at different temperatures in the range 200-440 K.
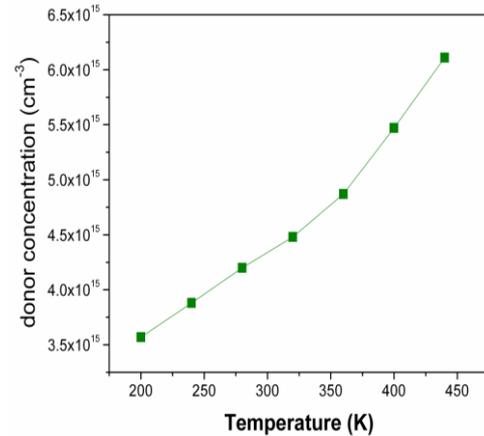

Fig. 9. Temperature dependence of the carrier concentration from experimental reverse bias C^{-2}-V characteristics for the Pt/Ti/n-InP Schottky diode.

The discrepancy between ΦI-V and Φc-v as well as the strong temperature dependence of ΦI-V and net low temperatures can also be explained by assuming a Gaussian distribution of BHs with a mean value $\overline{\Phi}_{bo}$ and standard deviation σo [3, 28, 33-36]. Werner and Guttler [3] have algebraically confirmed that the current-barrier values (ΦI-V) are lower by a value which depends on the standard deviation σo, whereas, the capacitance depends only on the mean band bending ($\overline{\Phi}_{bo}$) and it is insensitive to the standard deviation σo of the barrier height distribution (PΦbo). The difference between the measured I-V and C-V Schottky barrier heights in the metal/semiconductor is also an evidence for Schottky barrier height inhomogeneity.

For the difference in BH value, some general reasons have been reported in the literature such as surface

contamination at the interface, deep impurity levels, an intervening insulator layer, quantum-mechanical tunneling, image-force lowering and edge leakage currents [32, 37-38]. The measured I-V barrier height is significantly lower than the weighted arithmetic average of the SBHs. In contrast, the C-V measured BH is influenced by the distribution follows the weighted arithmetic average of the SBH inhomogeneity. Hence BH determined by C-V is close to the weighted arithmetic average of the SBHs. Therefore, the SBH determined from the zero-bias intercept assuming thermionic emission as current transport mechanisms is well below the C-V measured BH and the weighted average of the SBHs [3, 38].

4. Conclusions

The current transport mechanism in Pt/Ti/n-InP Schottky barrier diodes has been investigated by means of I-V and C-V measurements at various temperatures between 200-440 K. The value of the barrier height and ideality factor are 0.47 eV and 3.26 at 200 K and 0.74 and 1.21 at 440 K respectively. While the zero-bias barrier height Φbo increased, ideality factor n and series resistance Rs decreased with increasing temperatures. The calculated value of mean barrier height ($\overline{\Phi}_{b0} = 0.93$ eV) and standard deviation ($\sigma o = 0.128$ eV) clearly indicates the presence of interface inhomogeneities and potential fluctuation at the interface. It is seen that the barrier height deduced from I-V measurement is always smaller than the arithmetic average of the barrier height deduced from C-V measurements. This difference is mainly due to the presence of a thin compensated layer at the interface. Schottky barrier diode can be explained by the Gaussian distribution of barrier heights. Furthermore, the modified $\ln(Io/T2)-q2\sigma o2/2(kT)2$ versus 1000/T plot has given $\overline{\Phi}_b$ and A* as 0.94 eV and 6.23 A/cm^{2}K2, respectively. The Richardson constant value is in close agreement with the theoretical value of 9.4 A/cm^{2}K2 for n-type InP. The above results suggest that the experimental data of the present Pt/Ti/n-InP Schottky diode can be explained by assuming the existence of Gaussian distribution of the Schottky barrier heights in the wide temperature range.

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