شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم

شبكة المعلومـــات الجامعية

التوثيق الالكتروني والميكروفيلم

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الالكتروني والميكروفيلم

﴿ قـسـم ﴾

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأفلام قد اعدت دون آية تغيرات

يجب أن

تحفظ هذه الأفلام بعيداً عن الغبار

في درجة حرارة من 15 – 20 مئوية ورطوبة نسبية من 20-40 %

To be kept away from dust in dry cool place of
15 – 25c and relative humidity 20-40 %

بعض الوثائق الأصلية تالفة

بالرسالة صفحات

لم ترد بالأصـــل

ELECTRICAL PROPERTIES OF INP SEMICONDUCTOR DOPED WITH IRON

THESIS
Submitted for the partial fulfillment of
M.Sc.degree in Physics

To
Department of Physics, Faculty of Science
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1998

TO MY GODFATHER

EL-SHEIK

RASHAD EL-SHABOURY

WHO SUPPORTS, PROTECTS & GUIDES ME,

MY DEEPEST APPRECIATION.

ACKNOWLEDGMENT

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I would like to express my deep thanks to Prof. F.T.Abdel-Haleem, Dean of the Faculty of Science, Minia University.

I am greatly indebted to Prof. T.G. Abdel Malik, Head of the Physics Department, Minia University, for suggesting the point of investigation, his guidance, valuable advice and continuous supervision as well as stimulating the discussions through out this work. I would also like to thank Dr.R.M. Abdel-Latif, Physics Department, Faculty of Science, Minia University, for his great help, continuous advice and supervision through out this work.. Also, my deep thanks and gratitude are due to Dr.S.A.Darwish, Physics Department, Faculty of Science, Minia University, for his help, continuous advice, supervision and encouragement

Finally, thanks to the staff members of the Physics Department, for their support and appreciated help.

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ABSTRACT

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Measurements of the electrical properties of iron-doped indium phosphide single crystals which have been pulled from the melt by the liquid encapsulation Czochralski technique have been investigated using aluminium and gold electrode combinations. Samples with two aluminum electrodes showed ohmic conduction at low applied voltage. Above a threshold voltage V_t a power law dependence of current density on applied voltage was observed indicating space-charge limited conductivity. The results were accounted for in terms of an exponential distribution of traps $N(E)=N_o \exp(-E/kT_l)$ where typically $N_o=3\times10^{41}J^{-1}m^{-3}$ and $T_l=852K$. Measurements of current density-temperature characteristics yielded voltage variable slopes on plots of the logJ as a function of $1/T$, in accordance with the theory for exponential trap distribution. Measuring parameters for InP:Fe were; electron mobility $0.18m^2V^{-1}s^{-1}$ and a thermally generated electron concentration n in the conduction band at room temperature of about $5\times10^{13}m^{-3}$.

Samples having one electrode of each metal showed different behaviour. At low voltages (V≤ 400 mV) under forward bias (aluminium electrode negative), Schottky diode behaviour was observed. At applied voltages greater than 400mV, the forward characteristics showed a similar overall trend to that of Al/InP:Fe/Al samples i.e ohmic conduction followed by space- charge limited conductivity controlled by an exponential trap distribution. Under reverse bias, the conduction processes were interpreted in terms of both the Poole- Frenkel and Schottky effects. Barrier height and widths were determined as a function of applied voltage. The results showed that with the increase of voltage, the barrier width increased appreciably but the barrier height retained almost the same value. The Schottky barrier capacitance of Al/InP:Fe/Au samples was measured as a function of voltage in the range -0.6 to +0.6V at room temperature and analysed in terms of existing theory. Results obtained showed linear dependence of C^{-2} on V, with barrier heights in the range 0.65 - 0.77eV, and charge carrier concentrations of

(5.3-8.2)x$10^{21}m^{-3}$ which were mainly traps.

Measurements were made of the ac properties of InP:Fe using aluminium electrodes. These were performed over a frequency range of 5x10^{3}Hz to 1x10^{5}Hz at temperatures in the range 302 to 398K. The ac conductivity $\sigma(\omega)$ was found to vary with angular frequency ω as ω^{s}, where $s \leq 1$ at lower temperatures and higher frequencies. At higher temperatures and lower frequencies free band conductivity observed. Capacitance and loss tangent were found to decrease with increasing frequency and increase with increasing temperature, in good qualitative agreement with existing equivalent circuit model (see section 3-5) assuming ohmic contacts.

CHAPTER I
INTRODUCTION