HIGH ENERGY ELECTRONIC EXCITATIONS
IN
SEMICONDUCTORS

by

RITA GUPTA

(Physics Department)

Thesis submitted in fulfilment of the requirements
of the degree of
DOCTOR OF PHILOSOPHY

to the
INDIAN INSTITUTE OF TECHNOLOGY, DELHI

April, 1980

CERTIFICATE

This is to certify that the thesis entitled "HIGH ENERGY ELECTRONIC EXCITATIONS IN SEMICONDUCTORS", which is being submitted by Miss Rita Gupta for the award of degree of Doctor of Philosophy, to the Indian Institute of Technology, Delhi, is a bonafide record of research work. She has worked for the last four years and eight months under my guidance and supervision.

The thesis has reached the standard, fulfilling the requirements of the regulations relating to the degree. The results obtained in this thesis have not been submitted to any other University or Institute for the award of any degree or diploma.

K P Jain
16/5/81
(K.P. JAIN)

Acknowledgements

I owe a debt of gratitude to Prof. K.P. Jain for his constant guidance and kind encouragement at all stages of this work.

I thank my friends for their help and moral support. Special mention must be made of my colleague Jayanthi, working with whom has been a pleasure.

I also thank Mr. Ranjit Kumar for his neat typing, particularly the mathematical equations in the manuscript.

Finally, the awards of fellowship from NCERT and DST are gratefully acknowledged.

RITA GUPTA

ABSTRACT

High energy electronic transitions between core level and conduction band, in semiconductors, are studied in this thesis. The highly localized nature of the core states involved necessitates different treatment of these transitions from that appropriate to low energy transitions between valence and conduction bands. [4] Self-consistent field theory of Ehrenreich and Cohen [3] for ordinary low energy transitions in semiconductors is reformulated to incorporate high-energy dielectric function, neglecting many-body effects.

Many-body effects in core to conduction band transitions manifest themselves quite differently from those in valence to conduction band transitions. Final-state effects associated with high-energy excitations in semiconductors are studied using the techniques of many-body theory. These effects result in various shifts in threshold energy for transitions under consideration. Simple models are proposed to estimate these final-state effects, which are then compared with energy shifts measured experimentally.

LIST OF CONTENTS