INVESTIGATION OF THE ROLE OF DMS/NON-DMS INTERFACES ON MAGNETO-OPTICAL PROPERTIES OF SMALL OFFSET SUPERLATTICES

Abstract

by

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The main emphasis of this thesis is the investigation of magneto-optical properties of small offset superlattices that are formed by growing alternate layers of ZnSe and $Zn_{1-x}Mn_xSe$ (diluted magnetic semiconductors). Two series of samples were grown with different concentrations of Mn (10 and 15 %). Transmission experiments were conducted in Faraday geometry in magnetic fields of up to 5 Tesla at 1.6 K.

The organization of this thesis is as follows. The first two chapters present the basic features of the 8-band k·p model that is used in the calculations of the electronic states in semiconductor superlattices. The third chapter provides details about the model of optical transitions. Chapter 4 outlines the experimental method and the details regarding sample preparation. Chapter 5 presents the transmission spectra for various samples. The ground state transition was identified as the main transition in all the samples. It is noted that the traditional methods for the calculation of exciton binding energy enhancement are not very useful for these small offset systems. A simple and consistent method (Fractional Dimension Analysis) for estimating binding energy

enhancement for the ground state excitonic transition is proposed in Chapter 6. Chapter 7 presents the results of calculations. It is realized that there is a systematic discrepancy between the observed data and the calculations. The source of this discrepancy is magnetic in nature. It is shown that the problem lies with the nature of the DMS/non-DMS interface. The interface is modified from its "ideal" step-like nature to an extended form. The interface that explains the data satisfactorily accommodates the ideas of diffusion and the enhanced magnetism that characterizes the interface. In Chapter 8 the transitions between excited states are discussed. It is shown that the extended interface model represents a significant improvement over the "ideal" case for these higher order transitions. This is an important evidence for the validity of the enhanced interface model that is proposed in this thesis, since it consistently explains all the observed transitions.