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Linearly polarised photoluminescence in ZnSe/BeTe superlattices with no common atom at the interfaces

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Abstract. Photoluminescence spectra of type-II ZnSe/BeTe superlattices were studied. A linear polarised photoluminescence has been found in the spectral range of spatially indirect exciton transitions. This observation is interpreted in a model of optical anisotropy of heterostructures with no common atom at interfaces.

A number of publications have appeared recently devoted to studies of an optical anisotropy of heterostructures with no common atom at interfaces. This effect is attributed to the low local symmetry of the single interface between two different zinc-blend type materials. The interface has the C_{2v} symmetry instead of the D_{2d} in the bulk that allows to observe an optical anisotropy in the structure plane [1]. Microscopically the anisotropy can be treated in the terms of a heavy-light hole states mixing on the interface [2]. In a perfect quantum well the contribution from both QW interfaces to the anisotropy compensate each other and no resulting anisotropy can be found. One of the way to observe this anisotropy is to create non equal interfaces in quantum wells. This effect can be realised in heterostructures with no common atom at the interfaces, e.g. ZnSe/BeTe.

In present paper we use a type-II superlattices ZnSe/BeTe to study the in-plane anisotropy. An exciton photoluminescence (PL) of indirect transition between an electron from ZnSe and a hole from BeTe has been investigated.

The samples were grown by MBE on (100)-oriented GaAs substrates. During a growth the type of interfaces was controlled. Three type of ZnSe/BeTe (50/100 Å) × 20 periods samples were grown with BeSe... BeSe, ZnTe... ZnTe or BeSe... ZnTe interfaces.

PL measurements were performed in a temperature range 6–70 K. Photoluminescence was excited by 4416 Å He:Cd laser that is close to a direct exciton in ZnSe [3]. A linearly polarised excitation along [110], [1$\bar{1}$0] and [100] and a circulary polarised excitation were used.

We have found that independently of the polarisation of the excited light the resulting photoluminescence was polarised along [1$\bar{1}$0] direction (see Fig. 1). The degree of this polarisation was determined by the type of the interface. For the structures with nominally equal interfaces ZnTe... ZnTe the degree of polarisation was found to be of 30% and for BeSe... BeSe of 15% or even less. For the structures with non equal interfaces (BeSe... ZnTe) it was about 80%.

For spatially indirect excitons the hole wave function is strongly localised at the interface. This leads to increasing of a heavy-light holes mixing in comparison with type-I heterostructures.

A small value of the linear polarisation in the structures with nominally equal interfaces could be related with a different quality of the direct and indirect interfaces. This non-equality is due to the large difference of the chemical activity of Be to Zn and Se to Te. This leads also to the decreasing of the quality of the (ZnTe) as well as (BeSe) interfaces on the BeTe layer. At the same time on the ZnSe layer both interfaces can be grown of high quality.

A temperature dependence shows a fast suppression of the PL signal and a conservation of the polarisation.

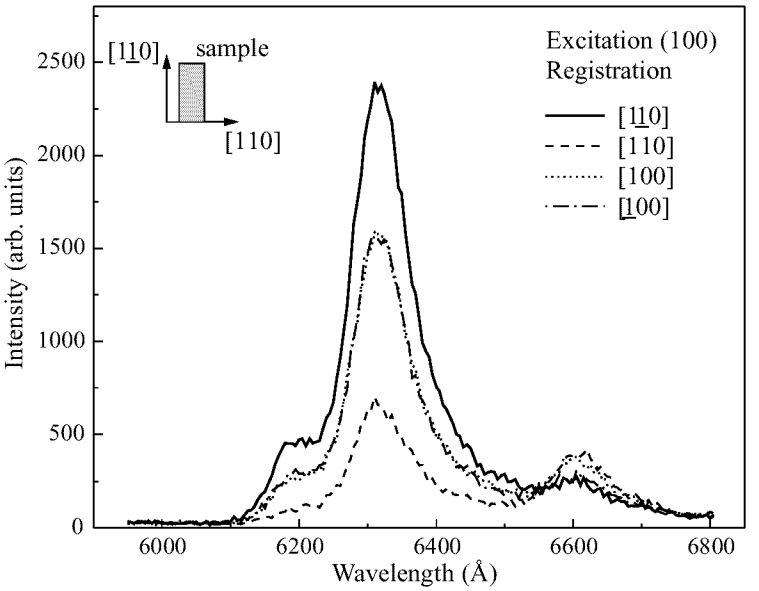

Fig 1. PL spectrum of ZnSe/BeTe superlattice with non-equal interfaces ZnTe...BeSe measured at $T = 6$ K.

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