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Impact of Insulator on the Properties of Piezotronic Field Effect Transistors

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ABSTRACT We have studied the effect of insulator transition on field effect transistors based on Piezotronic structure. The effect of polarization on the properties was examined for different semiconducting materials. For this purpose third generation semiconducting materials were used. In the sensing system zinc oxide, gallium nitride and cadmium sulphide were used. The coupling of Piezoelectric produced transport which were able to control the properties of carrier generation. The tunneling effects were utilized for reduction of swing limitation. The quantum field effect affected the limitation of two dimensional cases. Indium Arsenide compound quantum well were used for the study and worked as insulator and affected the properties of field effect transistors. In this process the polarization also played a crucial role in the study. In this study magnetic perturbation were considered for the study of properties of Piezotonic field effect transistors. The field effect transistors fabricated considering these properties produced high performance ability.

KEYWORDS Insulator transition, Piezotronic, polarization, transport carrier generation, perturbation.

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INTRODUCTION

Wu and Wang[1-2] studied the semiconducting materials for using in the sensing system having third generation condition. Lai et al.[3] and Sun et al.[4] studied the process of controlling the generation of carriers during recombination. An et al.[5] studied Piezotronic and Piezophotonic effects of atomically thin Zin oxide nano sheets. This device have photosensitivity of higher range. Hu et al.[6] studied the properties of insulators for low power states of surfaces. Hu et al.[7] presented the effect of polarization on phase transition which induced spin qubits[8]. Nazir et al.[9] studied the properties of field effect transistors based on the semiconductors have met al. oxide. The Boltzmann equation limit was utilized for the calculation of results[10].

Hoffmann et al.[11] presented the negative capacitance of ferro electric having insulator properties and having the properties of tunneling field effect transistors[12]. Nadeem et al.[13] made study of superceed the previous theory of quantum field effect for two directional limitations in the case of topological cases. Molle et al.[14] and Tareen et al.[15] studied experimentally growth of Xene of poor quality but for high quality it was not done by them. Riel et al.[16] studied the spatial dimension for high performance in the cae of group III-V compound semiconductor quantum wells. Seidl et al.[17] studied the Wurtzite and Zinc blende combination of indium arsenide. Quantum wires using chemical process for the growth of met al.o-organic length and width. Staudinger et al.[18] studied III-V Wurtzite film by using substate of zinc blende for the growth of diameter having different dimensions and in the case of [111] direction was presented by Li et al.[19], Becker et al.[20] and Miller et al.[21].

METHOD

We have used quantum Piezotronic device dependent on Wurtzite and zinc blende combination of Indium Arsenide quantum well consisting the properties of insulator. The polarization was used to produce phase transition of topological cases. The topological insulator were robuted to the perturbation of magnetic fields. The split gate structure was taken into account which was based on quantum point contact. The width of quantum point contact was balanced by gate potential on split gates. The Piezoelectric polarization was found by using the relation $P_i = e_{ijk}.S_{jk}$ [22-23] and formulated equation

$$\sigma = C_E S - e_E{}^T E,\ D = e_E S + K.E.$$

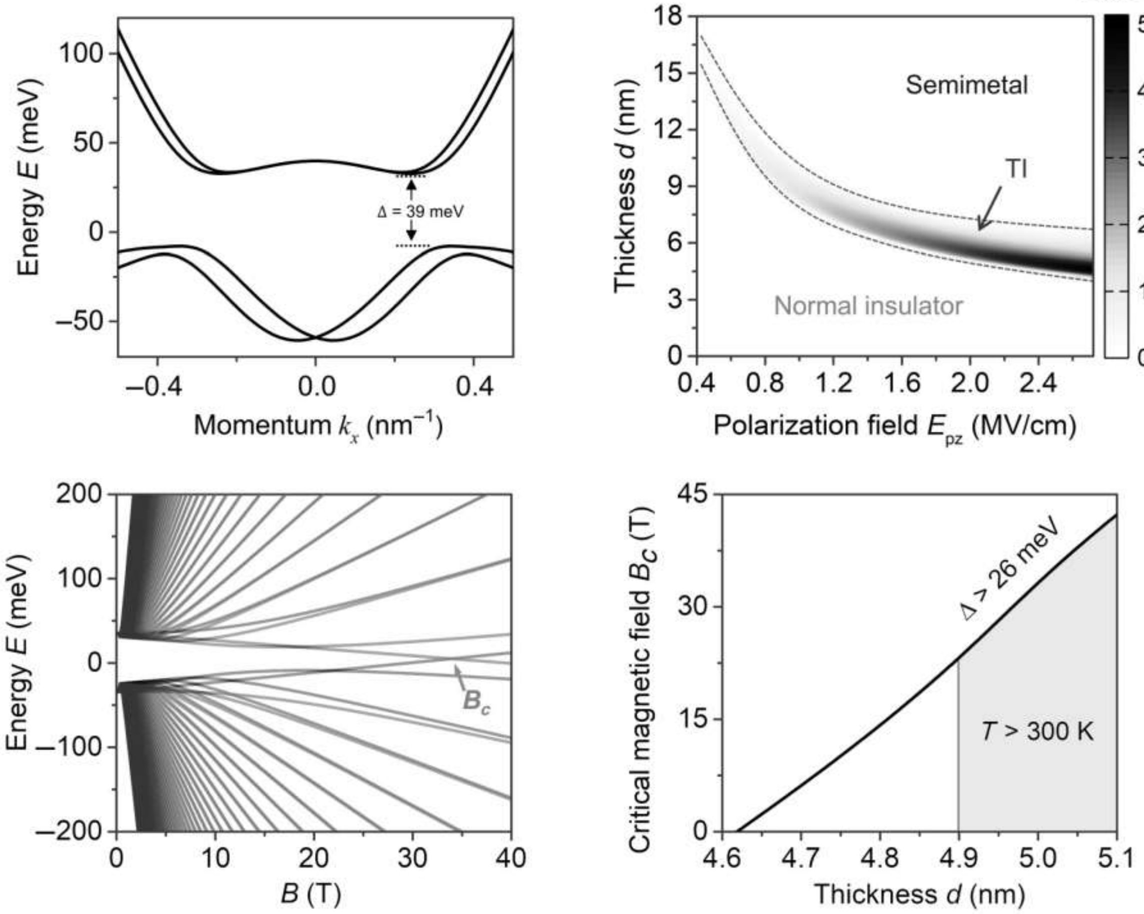
Where P and S are polarization vector and strain vector. e_{ijk} is the piezoelectric tensor, e_E^T is the transposed matrix of $e_E.\sigma$ and C_E is the stress and elasticity tensors. *E* is the electric and *D* is the displaced and *K* is the dielectric tensor. The band structure quantum wells were calculated by using eight band K. P. Hamiltonian[24]. The conductance was calculated for quantum wells by using the Landauer-Buttiker formula[25].

$$G = \frac{e^2}{h}\sum_{m,n}\left|T_{mn}\right|^2$$

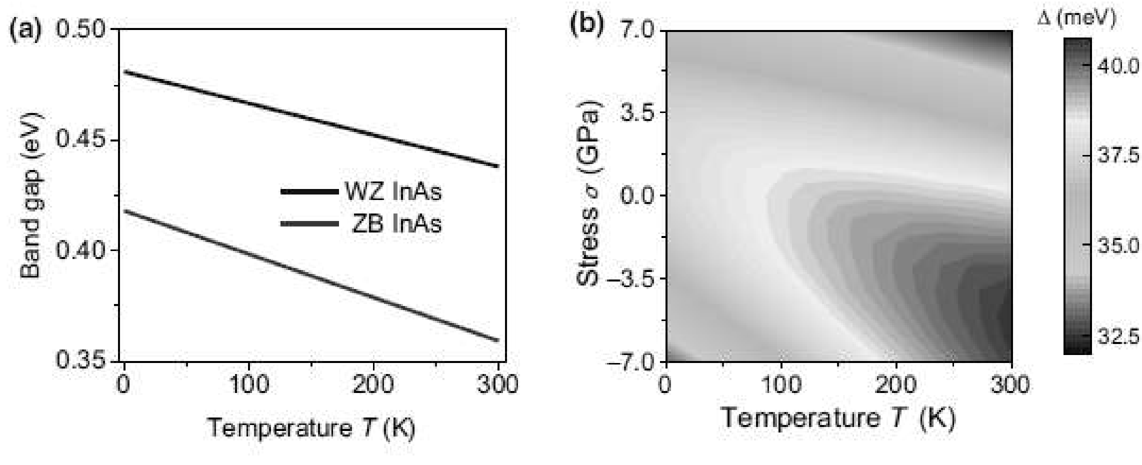
Where *h* is the plank constant, T_{mn} is the coefficient of transmission for the electrons.

RESULTS AND DISCUSSION

We have studied the impact of insulator on the properties of piezotronic field effect transistors. The effect of polarization on the properties of Wultzite/Zinc blende quantum wires of Indium Arsenide was also studied. The band gap was calculated. The conductance of quantum wells were also calculated using Landauer Buttiker formula. The band structures of quantum wells of Wurtzite/Zinc blende Indium Arsenide were calculated. Graph (1) shows the plot of band structure of quantum well of Indium Arsenide. This was calculated using eight band K. P. Hamiltonian. This is shown in Graph (1) (a). Graph (1) (b) shows the effect of electric field on band gap. The spontaneous polarization produced the coverness of the gap. It was found that quantum wells were greatly robust to magnetic fluctuations. Graph (2) shows the plot of band gap as a function of polarization field. Graph (2) (a) shows that band gap of Wurtzite/Zinc blende of Indium Arsenide decreased between 0 and 300K. The temperature affected the band gap. For Zinc blende the effect was higher than topological insulator. The energy gap of Indium Arsenide topological insulator changed with temperatures and showed weak sensitivity of temperature. The band structure presented topological phase transition towards topological insulator. The bulk band having finite width generated bulk energy gap. The band gap was larger than topological insulator in Indium Arsenide quantum well. The magnetic fluctuation was examined and were used to calculate the robustness of topological insulator. The obtained results were compared with previously obtained results.



Graph 1: Plot of band structure of quantum well of Indium Arsenide



Graph 2: Plot of band gap as a function of polarization field.

CONCLUSION

We have studied the impact of insulator on the properties of piezotronic field effect transistors. The transistor device is dependent on topological insulator in the case of Wurtzite/Zinc blende Indium Arsenide quantum wells. The swing process has important role in the fabrication of field effect transistors. In this study the Boltzmann tyranny limit was used to calculate the results. The conductance role and tunneling were used in the study. The removal of limitation was made using quantum field effect in topological cases. The study of two dimensional cases were used. The calculations of band gap, conductance and polarization of piezoelectric effect were made. The band structures were studied and calculated using K. P. Hamiltonian. We have found that topological phase transition occurred from normal to topological insulator. The survival of edge stae was found in several magnetic fields and it was used to obtain robustness. The band gap was decreased in quantum wells of Indium Arsenide Wurtzite cases. The temperature affected the band gap and was found higher in comparision to topological insulator. The poor sensitivity was found in the multilayer of Alumunium Antimonide and Gallium Antimonide combination. The found results were in good agreement with previously obtained results.

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