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Pressure tuning of HgCdTe epitaxial layers - the role of the highly disordered buffer layer.

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$Hg_{1-x}Cd_xTe$ alloys are unique because by increasing the Cd content x, one modifies the band structure from inverted to normal. Additionally application of hydrostatic pressure (p) can be used for studying the evolution of Dirac matter and its topological properties [1].

In this work, high-quality $Hg_{1-x}Cd_xTe$ MBE-grown epitaxial layers with $x \approx x_c$ were studied using pressure cell (Fig A) and magneto-spectroscopy methods. Special attention is paid to elucidate the role of the substrate and buffer layers, which usually modify pressure coefficients of epitaxial layers. For this purpose, comparative measurements were carried out on as-grown epilayers with a GaAs substrate and on free-standing layers obtained by etching off the substrate. Spectra registered as a function of B (at given p) were analyzed with the help of a modified Kane model, showing a pseudo-relativistic energy band dispersion. The pressure coefficient as well as the difference between conduction and valence band deformation potentials of the free-standing layer were determined at 2 K for the first time. Surprisingly, the deformation potentials and pressure coefficients of the epitaxial layer and those of the free-standing layer differed by no more than 10% in the pressure range up to 4.2 kbar. This finding questions the common belief of a dominant influence of the substrate on the pressure coefficients of epitaxial layers. We attribute the smallness of this difference to the presence of a highly disordered CdTe buffer separating the substrate from the epitaxial layer, which relaxes the transmission of strain from the substrate to the layer.

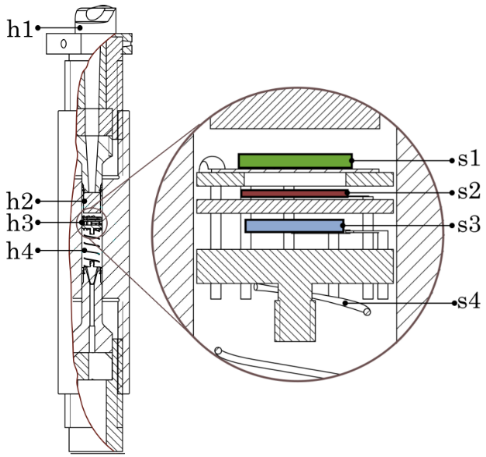

Fig. A cut-away diagram of the pressure cell and sample holder: h1 - optical cone; h2 - sapphire window; h3 - sample holder; h4 – pressure chamber; s1 - sample; s2 - bolometer; s3 - manometer; s4 - spring, which helps to keep the distance between the sapphire window and the sample constant.

Our results contribute to a better understanding of pressure-driven topological phase transitions both in $Hg_{1-x}Cd_xTe$ epitaxial layers as well as in HgTe-based quantum wells, which are bulk and two-dimensional Dirac materials, respectively [1].

REFERENCES

[1] R. Piotrzkowski, S. Porowski, Z. et al, Phys. Stat. Sol. **8** , (1965) K135-K139,.

[2] D. Yavorskiy, Y. Ivonyak,et al, (2024) arXiv:2406.16122v1