MBE growth of CdTe on hBN

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Hexagonal boron nitride (hBN) has been shown to be a perfect substrate for the growth of high optical quality 2-dimensional materials such as $MoSe_2$ [1]. The main advantages of hBN compared to other semiconductor materials is a very high energy gap (5.9 eV) and ultra-low roughness in the case of exfoliated hBN. The motivation of the present work is based on the observation that such properties of hBN could be also useful for the epitaxy of 2D structures formed from 3D materials, such as e.g. CdTe quantum wells (QWs). In such a case hBN could act both as a flat substrate and barrier material with a high energy gap.

The growth was realized by Molecular Beam Epitaxy on exfoliated hBN flakes deposited on Si (100) substrates covered by 90 nm of SiO_2. Despite the use of relatively small hBN flakes, the Reflection High-Energy Electron Diffraction (RHEED) was applied in order to observe the evolution of the surface during the growth of the structure. We tested the growth of various tellurides: CdTe, ZnTe, (Cd,Mg)Te, and their heterostructures. After the growth, samples were examined with Atomic Force Microscopy (AFM) and low-temperature photoluminescence (PL) was investigated.

Several samples were grown in various temperatures of the substrate during growth. For typical growth temperatures of tellurides (250-350°C) there was no observable deposition of material on hBN. The best results were obtained for the lowest temperatures, below 200°C. The AFM scans of hBN covered by II-VI materials revealed a polycrystalline structure with two different areas: with and without the influence of the electrons from RHEED. In the photoluminescence spectrum of samples with CdTe quantum wells with (Cd,Mg)Te barrier a sharp peak of a CdTe quantum well was observed in the area influenced by RHEED. Interestingly, in the area without the influence of RHEED PL of quantum wells was not observed by far. Also presence of hBN for the formation of high optical quality QWs is important, because areas where CdTe was deposited directly on SiO_2 (no on hBN flakes) revelaed only PL of (Cd,Mg)Te barriers, not CdTe quantum wells.

[1] W. Pacuski, M. Grzeszczyk, K. Nogajewski, A. Bogucki, K. Oreszczuk, J. Kucharek, K.E. Połczyńska, B. Seredyński, A. Rodek, R. Bożek, T. Taniguchi, K. Watanabe, S. Kret, J. Sadowski, T. Kazimierczuk, M. Potemski, P. Kossacki, *Nano Letters* **20**, 3058 (2020).