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THURSDAY SEMINAR

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Properties and applications of PbTe/CdTe nanocomposite

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The wide energy gap II-VI semiconductor, CdTe, and the narrow energy gap IV-VI semiconductor, PbTe, have been studied for years, thus their properties are well known. Both crystallize in cubic lattice structures with very similar lattice constants, making epitaxy of one material on another simple. However, their crystal structures are different - for PbTe it is a rock salt structure, and for CdTe it is a zinc blende structure. The crystal structure mismatch makes PbTe and CdTe immiscible. The interfaces between areas of pure PbTe and CdTe are very sharp, however, decorated with a large number of dangling bonds that can act as traps for mobile carriers from PbTe.

The goal of the seminar is to show that a mixture of nanometer-sized areas of pure PbTe and CdTe, i.e. a PbTe/CdTe nanocomposite, exhibits new or at least strongly modified features that lead to new functionalities and applications of the material. In particular, it will be recalled how perfectly shaped PbTe quantum dots are produced in a CdTe matrix and what their luminescent properties are. It will also be recalled that CdTe anti-dots introduced into PbTe improve its thermoelectric properties.

The main part of the seminar will be devoted to the latest research results of high-temperature infrared detectors made of PbTe/CdTe nanocomposite. Two types of detectors will be presented: photoresistors and photodiodes. In the latter case, the p-n diodes are made of wide bandgap II-VI semiconductors with narrow bandgap PbTe nano-inclusions introduced into the depletion region during MBE growth. Such diodes can be used not only for infrared sensing, but also for two-color infrared photovoltaics.