DEPARTMENT OF PHYSICS AND ASTRONOMY

COLLOQUIUM IN-PERSON ONLY EVENT

II-VI based organic-inorganic hybrid superlattices: structure, stability, properties, and potential applications

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A group of organic-inorganic hybrid nanostructures, for instance, ZnTe(ML)0.5, where ML = CnN2H2n+4 (n = 0, 2-4), have been shown to exhibit nearly perfect crystal structures, manifesting as high crystallinity comparable to that of a typical high quality III-V or II-VI binary and better than any known semiconductor superlattices. For instance, β-ZnTe(C2N2H8)0.5 has a 20-30" XRD rocking-curve linewidth, below 1 cm-1 low-temperature Raman linewidth, and band-edge free exciton emission (~3.56 eV) without below-bandgap emission. More interestingly, it offers various highly desirable properties, e.g., room temperature excitonic emission due to a large exciton binding energy estimated to be around 300 meV, strongly enhanced optical absorption as high as 106 cm-1, close to 100% internal quantum efficiency in room-temperature photoluminescence, zero-thermal expansion over a broad temperature range, and much reduced density and dielectric constants. Uniquely, it is the only hybrid that exhibits an over-15-year shelf life, benefiting from a relatively large formation energy and kinetic barrier. These novel properties suggest many potential applications, including room-temperature exciton-polariton condensation, efficient UV emission and detection, transparent electronics and p-type conductive material. It serves as a rather unique prototype material group to illustrate a number of basic topics of solid state physics.

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IN-PERSON EVENT ROOM 202

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