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# Raman Scattering as a Probe of Crystallinity in PTCDA and $H_2Pc$ Single-Layer and Double-Layer Thin Film Heterostructures

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**Abstract:**

The vibrational properties of single-layer PTCDA (perylene-3,4,9,10-tetracarboxylic dianhydride) and $H_2Pc$ (metal-free phthalocyanine) thin films and PTCDA-$H_2Pc$ double-layer heterostructures are studied by Raman scattering. The evidence of crystallinity of the single-layer films can be supported by the existence of phonons, as well as polarization dependence. Resonance enhancement Raman scattering has been used to selectively measure the individual layer properties in double-layer $H_2Pc$/PTCDA and PTCDA/$H_2Pc$ heterostructures. When $H_2Pc$ is grown on PTCDA, its structure departs from the herringbone arrangement characteristic of unstrained $H_2Pc$ films, as demonstrated by the different peak intensities in the Raman spectra. Well-defined phonons and the polarization dependence in the $H_2Pc$ top layer are characteristic of long-range order, indicating that the $H_2Pc$ molecular planes in the templated structure are crystalline. No evidence for a new structure was observed for PTCDA deposited on top of a $H_2Pc$ first layer. Here, the relative intensity of the phonons in the PTCDA top layer demonstrates that the PTCDA forms microcrystallites due to strain at the molecular heterojunction, before relaxing to its bulk crystalline form.

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