Interface Science of Contacts and Interlayers in Emerging Thin Film Photovoltaics: Geometric and Energetic Heterogeneity

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The overall efficiencies of both organic and organic-inorganic hybrid solar cells have been rising at a remarkable rate for research grade cells, over the last decade, but there continue to be basic scientific issues that prevent us from bringing these efficiencies to massively scalable, inexpensive platforms that appear to originate in both the geometric and energetic heterogeneity of the interferes between electrical contacts, thin interlayer films and these new active layer materials. This talk will focus on a few examples that we have been recently exploring, both crystalline and polymeric active layer systems, where we have mapped out the electrical property heterogeneities using conductive scanning probe microscopies, and the energetic heterogeneities using high sensitivity, high resolution photoemission spectroscopies, where in both instances we see correlations between this heterogeneity and device performance. In both instances it appears that the organization of molecules at the first 1-5 nm between the contact and the active layer are, not surprisingly, critical to the performance of these devices, and suggest an increased emphasis on these regions will be needed to bring there energy conversion technologies to fruition.

Two-dimensional nonlinear terahertz spectroscopy on solids and nanostructures

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In the spectral range of terahertz frequencies (1 - 30) Thz there are many elementary excitations of crystalline matter, e.g. Phonons, plasmons, intersubband transitions in semiconductor nanostructures, etc. Electro-optic sampling of the THz field transients gives the full information about the nonlinearly emitted field from the smaple. In the talk I will discuss various 2D-experiments on semiconductor quantum wells, LiNbO3, and epitaxial multi-layer graphene which provide direct microscopic insight into phenomena like, interband tunnelling, nonlinear carrier trasnprt, and coherences of interband transitions. Finally, I will discuss briefly the planned experiments on HIOS samples within the CRC 951.