

Hybrid approach to room temperature molecular based quantum devices

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Quantum nano- optics devices are likely to become primary components of future electronic devices. Practical realization of quantum devices faces a number of challenges. However, the benefits from the successful implementation of these devices can be enormous. Nature in several cases uses quantum mechanics in order to achieve extraordinary properties. One known examples is the high photon conversion efficiency in photosynthetic light harvesting complexes. In this example the most striking feature is the use of coherence properties and quantum mechanics in the short scale while the measurements and results are classical in the large scale. In my lab we aim to mimic nature and create nano tool box bottom up approach which enables high temperature quantum operation coupled to top down classical semiconductor measurement device (See [1] for example).

This methodology is producing a generic technology for constructing nano-systems in which many devices are interconnected and operate in unison, without inhibiting their quantum nature. In the talk we will present our efforts to achieve confinement potential control using different dots systems [2,3] as well as charge and spin transfer control in our hybrid dots systems [4]. We will show our recent results in which we were able to discover a collective electron transfer process by studying the current noise in a field effect transistor with light-sensitive gate formed by nanocrystals linked by organic molecules to its surface [5]. A demonstration of a room temperature operating hybrid quantum sensor will be presented, together with antennas for enhancing the efficiency of solar cells.

We hope that by controlling the quantum and classical behavior of the self assembled layers we will be able to create novel and revolutionary devices mimicking some of Nature's complex structures. One such example would be mimicking the light harvesting complexes in a controlled self assembled design. Using the flexibility of the design we can realize systems which will test the some of the suggested quantum theories. Further into the future we aim to use this knowledge for applicable devices such as increasing the efficiency of solar cells coupled to simple Si based devices.

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- [2] S. Shusterman et al. Europhys Letters **88** (2009) 66003.
- [3] D. P. Kumah et al. Nature Nanotechnology **4** (2009) 835.
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- [5] Y. Paltiel et al. Phys. Rev. Lett. **104**, 016804 (2010).