Polymer OLEDs for Solid State Lighting

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The promise of organic electronics lies in the potential for building large area electronic devices with much lower cost than possible with conventional silicon-based technology. The main reason for this is that the organic active layers of the device can be applied using low cost printing techniques that are compatible with high volume "roll-to-roll" manufacturing. Example organic electronic devices include organic light emitting diodes (OLEDs), organic photovoltaic cells, thin-film transistors, organic sensors, and radio-frequency identification tags. There has been worldwide research and development in these technology areas but so far there has not been a demonstration that the full potential of organic electronics can be utilized in a real application.

OLED technology is perhaps the most mature of the organic electronic device technologies. It has progressed to the point where it is now possible to envision OLEDs as a future-solid state light source for general illumination. Achieving this goal will require substantial improvement in the performance of the OLED device itself as well as the development of a new manufacturing infrastructure that can realize the large area, low cost potential of organic electronics. In this talk, the key challenges that must be overcome to enable OLED lighting will be enumerated and our efforts aimed at solving them will be described.

Keywords:

*Organic Light-Emitting Diode (OLED)***:** A low voltage, solid state light source with rectifying current/voltage behavior. An OLED consists of one or more organic layers sandwiched between two electrodes – one of which must be transparent. The organic layers are amorphous or highly disordered films with a total thickness of only ~100 nm. When a voltage is applied across the device, electrons and holes are injected into the organic layer(s) from opposing electrodes. These hop between molecules, or polymer segments, under the influence of the electric field until they meet at the same molecule or segment and form a neutral bound excited state or exciton. A fraction of these relax through a radiative process and hence light is emitted. The color of the light emitted can be tuned by modifying the chemical structure of the organic materials and the details of the device design.

*Luminous Efficacy***:** This is the primary measure of efficiency of a light source for lighting. It is measured in terms of the lumens output from the source divided by the electrical power input (lumens per watt). The lumen is a measure of radiated optical power that is normalized to the human eye sensitivity. Thus, two light sources that radiate the same amount of optical power but with different spectral characteristics will typically not exhibit the same lumen output.