neighboring Tb^{3+} resulting in a reduction in luminescence.

In addition, the emitting color varied from bluish-green to greenish-yellow with increasing Tb^{3+} content. Excited at 330 nm, the Commission International de l'Eclairage (CIE) chromaticity coordinates shifted from (0.25, 0.33) to (0.40, 0.52) as the value of y increased from 0.1 to 0.6 in the $Mg(Y_{3.8-y}Ce_{0.2}Tb_y)Si_3O_{13}$ materials.

Melissa A. Harrison

Energy Focus

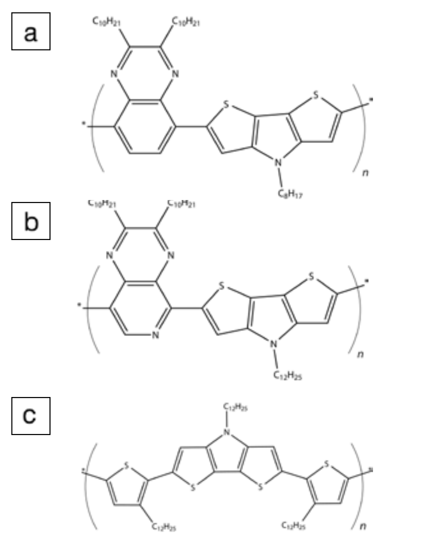
Quantum efficiency improved in bulk heterojunction PVs

Although bulk heterojunction photovoltaics (BHJs) are attractive as low-cost solar cells due to their ease of processability, devices incorporating low-bandgap quantum dots (QDs) fall short of the performance achieved by analogous blends of polymers and CdSe QDs. Previously, D.S. Ginger, S.A. Jenekhe, and co-researchers at the University of Washington, Seattle, hypothesized that the poor performance by BHJs composed of PbS QDs blended with common conjugated polymers is due to insufficient photoinduced charge transfer at the organic–inorganic interface. Recently, Ginger and co-researchers showed that BHJs made from PbS QDs and new donor–acceptor polymers exhibit efficiencies two orders of magnitude greater than those observed for blends of PbS with conventional host polymers.

As reported in the July 14th issue of *Nano Letters* (DOI: 10.1021/nl1013663; p. 2635), Ginger and co-researchers selected three polymers (PDTPQx, PDTPPPz, and PDTPBT; see figure) to blend with PbS QDs because their ionization potentials show that their highest occupied molecular orbitals lie within the PbS bandgap. Photoinduced absorption (PIA) spectroscopy shows that in the range of 0.8 eV to 2.2 eV BHJ blends of PDTPQx and PbS QDs exhibit new sub-bandgap absorptions by the PDTPQx and a bleach of the polymer's bandgap transition following photoexcitation, while the PDTPBT blend shows very weak PIA signal, and the PDTPPPz blend shows no detectable PIA signals. Because neat PDTPQx shows no PIA signal, the researchers attribute the blend's PIA spectrum to long-lived polarons on the PDTPQx polymer chains created by photoinduced electron transfer from the polymer to the PbS QDs, leading them to predict PDTPQx/PbS to perform significantly better in BHJ photodiodes than PbS QDs blended with either of the other two polymers considered. The researchers verified this prediction by showing that the quantum efficiencies exhibited by the PDTPQx/PbS blends are two orders of magnitude higher than those exhibited by blends with the other two polymers.

Under simulated AM 1.5 illumination, the researchers estimated a power conversion efficiency (PCE) of about 0.55%, which is modest in comparison to polymer-fullerene BHJ cells but is significantly higher than BHJ devices made from previous polymer blends with low-bandgap QDs. The researchers plan to improve performance by increasing the PDTPQx molecular weight to facilitate thicker films, and by controlling the shape of the QDs.

The researchers said, "We anticipate that the viability of new organic host materials when blended with PbS should reinvigorate the study of solution-processable bulk-heterojunction excitonic solar cells made with a range of low-bandgap nanoparticles and should facilitate their use in both hybrid photovoltaics and photodetectors with bandgaps tailored via quantum confinement."



Structures of the polymers used in blends with PbS quantum dots:
(a) PDTPQx: poly(2,3-didecyl-quinoxaline-5, 8-diyl-*alt*-*N*-octyldithieno[3,*2-b:2´*,3´-*d*]pyrrole);
(b) PDTPPPz: poly(2,3-didecyl-pyrido[3,4-*b*] pyrazine-5, 8-diyl-*alt*-*N*-dodecyl-dithieno[3, *2-b:2´*,3´-*d*]pyrrole); and
(c) PDTPBT: poly(2,6-*bis*(3-*n*-dodecyl-thiophen-2-yl)-*alt*-*N*-dodecyldithieno [3,*2-b:2´*,3´-*d*]pyrrole).

Steven Trohalaki

Normal modes and density of states achieved in disordered colloidal solids

Colloidal suspensions have been used as model systems in experimental research on the fundamentals of statistical mechanics. In colloidal systems, a crystal or amorphous structural glass can be produced using traditional hard-sphere particles such as silica sphere. However, the perfect crystals produced with these conventional particles show spatial homogeneous fluctuations. These fluctuations are measured using optical microscopy to observe individual particle motion within the interior of the system.

Recently, D. Kaya, N.L. Green, C.E. Maloney, and M.F. Islam of Carnegie Mellon University developed an approach to measure the correlation in particle displacement using strongly disordered colloidal crystals composed of deformable microgel colloidal particles to determine the normal modes and the density of states (DOS). Normal modes and the DOS of a

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