March 11 issue of *Chemistry of Materials*, Y. Shirota and co-workers from Osaka University in Japan reported the synthesis and properties of a novel class of high-performance, color-tunable emitting amorphous molecular materials with bipolar characters: 4-dimesitylboryl-N,N-bis(9,9-dimethylfluoren-2-yl)aniline (FlAMB-0T); 2-{4-[bis-(9,9-dimethylfluoren-2-yl)amino]phenyl}-5-(dimesitylboryl) thiophene (FlAMB-1T); 2-{4-[bis-(9,9-dimethylfluoren-2-yl)amino]phenyl}-2′-dimesitylboryl-5,5′-bithiophene (FlAMB-2T); and 5-{4-[bis(9,9-dimethylfluoren-2-yl)amino]phenyl}-5″-dimesitylboryl-2,2′:5′,2″-terthiophene (FlAMB-3T).

The molecular design of these materials is based on connecting both electron-donating and electron-accepting moieties (which undergo reversible oxidation and reduction) through a central π-conjugated system. In other words, the incorporation of the difluorenyl(phenyl)amine and dimesitylboron moieties provide both electron-donating and electron-accepting properties, respectively, and facilitated formation of amorphous glasses due to their nonplanar molecular structures. The central thiophene rings control the highest occupied and lowest unoccupied molecular orbital energy levels, depending on the material's π-conjugation length. The researchers reported that emission color can be tuned by varying the conjugation length of the thiophene unit.

The researchers reported the fabrication of electroluminescent devices using FlAMB-*n*T as emitting or host materials and the development of a high-performance white-light-emitting electroluminescent device using a bilayer combination of FlAMB-0T and FlAMB-3T.

ANDREI A. ELISEEV

Surface Properties Reversibly Switched Using Electrical Potential

A research team from the Massachusetts Institute of Technology (MIT), the University of California at Santa Barbara (UCSB), and UC—Berkeley have developed a process that dynamically changes interfacial properties by conformational transitions, or switching, of surface-confined molecules. Unlike other methods that involve chemical reactions, the team has demonstrated the ability to use an active stimulus, such as an electrical potential, to effect such changes without altering the system's environment.

As reported in the January 17 issue of *Science*, a self-assembled monolayer of (16-mercapto)hexadecanoic acid was prepared on a gold surface. This molecule was chosen because it has a hydrophobic chain and a hydrophilic group on one end; therefore, it may grant different properties to the surface, depending on which part of the molecule is exposed. In order to allow for the switching, the monolayers need to be less dense than conventional self-assembled monolayers; that is, sufficient spatial freedom must be established for each molecule. A monolayer with an optimum spacing between molecules was obtained using a precursor molecule with a globular head group. Hydrolysis of the globular group yielded a low-density monolayer of the molecule of interest.

In the equilibrium state, the molecules organized in a straight fashion on the surface, exposing their hydrophilic end. Joerg Lahann of MIT, Samir Mitragotri of UCSB, and co-workers observed that after applying an electrical potential to the gold surface, the molecules' end groups were attracted toward the charged surface, showing the hydrophilic chains. Sum frequency generation (SFG) spectroscopy was used to analyze the conformational states of the monolayer, since the intensity of the SFG spectrum is affected by the orientation of the molecules. The results show that an electrical potential changes the conformation of the molecules in the monolayer, and that the switching is a reversible process. Contact angles were measured over four switching cycles, and while a large hysteresis was observed, the drop in contact angle was also determined to be reversible. The researchers attributed the observed hysteresis to surface chemical heterogeneity and roughness.

According to the researchers, these findings have important implications for the dynamic control of macroscopic surface properties. The researchers identified applications in microfluidics, microengineering of smart templates, and microfabrication of controlled-release devices.

MARIA M. CORTALEZZI

Stable α-Phase Nickel Hydroxides Obtained with 10% Aluminum Substitution

Alpha-phase nickel hydroxides have recently been investigated in order to increase the performance of rechargeable alkaline batteries. The α-nickel hydroxide has a superior electrochemical capacity of 433 mAh/g theoretical and 350 mAh/g actual, as compared with β-nickel hydroxide at 289 mAh/g theoretical and 273

mAh/g actual. Utilization of the α-nickel hydroxide also avoids the formation of a γ-phase when overcharged, which results in cell breakdown. Researchers Wei-Kang Hu and Dag Noréus from the Department of Structural Chemistry at Stockholm University have fabricated pasted electrodes from a stable α-phase nickel hydroxide with 10 at.% Al substitution that display a higher specific capacity and weight energy density than β-type nickel electrodes.

Because the substitution element (Al in this case) does not participate in the electrochemical reaction, the concentration of substituted Al must be as low as possible. As reported in the February 25 issue of *Chemistry of Materials*, the Al concentration increases the spacing of the (001) planes in the rhombohedral α-phase nickel hydroxide structure, which decreases the tap density (from 1.2 g/cm^3 to 1.0 g/cm^3 as the Al content increases from 10 at.% to 30 at.%), leading to lower energy density with increased Al content. Experiments showed that samples with 10 at.% Al showed sufficient stability after aging in 6.0 M KOH for 48 days at room temperature with no β phase observed. In addition, no β phase was observed after 300 charge–discharge cycles in the NiMH battery cells.

AA-size α-type and β-type NiMH cells were constructed for material comparison. The results showed that the β-type nickel electrode has a capacity of 1500 mAh at a 0.2 C rate, while the α-type electrode displayed a lower capacity near 1100 mAh, due to its lower volumetric energy density. As the β-type nickel electrodes are already near their theoretical maximum, it is hoped that the results of this study, which show functioning α-type nickel pasted electrodes, will pave the way for further improvements in the weight and volumetric energy densities of these materials, leading to increased cell performance.

KYLE BRINKMAN