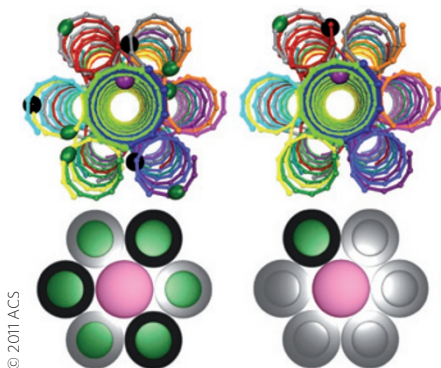


LIGHT-HARVESTING ANTENNAS

Holding on to DNA

J. Am. Chem. Soc. **133**, 11985–11993 (2011)



Using the energy of visible light to fuel chemical conversions in a similar manner to photosynthesis is extremely attractive. Multiple chromophore systems, attached to dendrimers or protein assemblies, have been constructed that are able to capture light and transport the excitation energy in one direction through donor–acceptor energy-transfer processes, but organizing a large number of multiple chromophores with precision remains challenging.

Yan Liu and co-workers from Arizona State University have now used a DNA

scaffold to prepare rapid and efficient light-harvesting antennas. A seven-helix DNA bundle, in which six helices surround a protruding one, holds cyclic arrays of three chromophores attached to the DNA fairly rigidly — either through a base or directly incorporated into the backbone — at well-controlled inter-chromophore distances. They are arranged to favour a stepwise energy transfer from the primary donor to the intermediate donor, then to the acceptor at the protruding site.

The researchers prepared a series of antennas in which the relative ratios between the three chromophores are varied, and studied their energy-transfer processes and light-harvesting abilities. In all cases, the only energy transfer observed was a stepwise, unidirectional transfer cascade from the primary donor to the secondary, and then to the acceptor, demonstrating the efficacy of the DNA scaffold. The light-harvesting abilities of the antennas were most efficient when a large number of donor chromophores were present. *AP*

SOLID CATALYSTS

Pores within pores

Science **333**, 328–332 (2011)

Zeolites — crystalline aluminosilicate materials with pores below 2 nm — are very

widely used as catalysts in industry. They represent about 40% of all the solid catalysts used, but do have their limitations: their small pore size means they are limited to reactions involving small molecules. For larger molecules, mesoporous molecular sieves (MMSs) have been suggested, because they have pore sizes between 2 and 50 nm. Their catalytic activities, however, are limited because their pore walls are not crystalline and thus do not contain the number of acidic active sites that zeolites do.

Now, a collaboration led by Ryong Ryoo of KAIST report a mesoporous material in which the pore walls are themselves a microporous crystalline zeolite framework. The hierarchical porosity was created using quaternary ammonium surfactants as templates and crystallization directors. One example of this material contains a head group made up of three quaternary ammonium anions spaced by C_6H_{12} tails; appended to this are two hydrophobic $C_{18}H_{17}$ tails. This creates a hexagonally ordered MMS with crystalline zeolite walls 1.7 nm thick. Other similar surfactants produced MMSs with different wall thicknesses and structures.

Ryoo and colleagues tested the catalytic activity of their hierarchically porous material on relatively bulky organic molecules. Their activities were higher

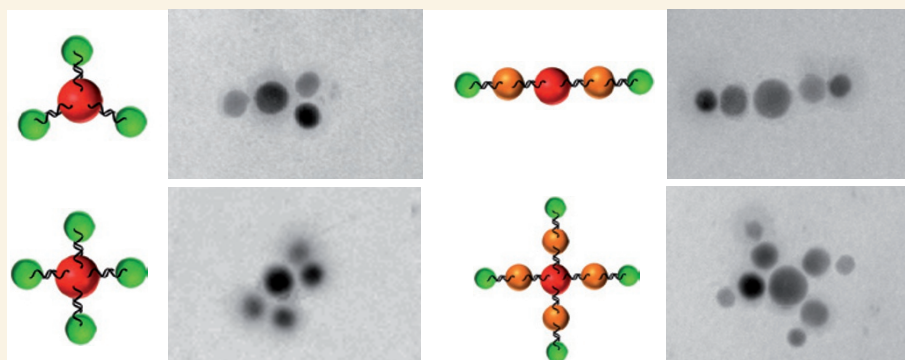
NANOTECHNOLOGY

Quantum dot bricks and DNA mortar

Nature Nanotech. **6**, 485–490 (2011)

Since the birth of modern chemistry, chemists have been trying to understand how to join specific atoms to others to create molecules with interesting properties. Some chemists have moved up a length scale as they look to bring nanometre-sized units together, and now a team led by Ted Sargent and Shana Kelley at the University of Toronto have developed a simple method that uses DNA ‘bonds’ to join various quantum dot ‘atoms’ together, giving them control over the possible binding partners and valency of the quantum dots.

They make DNA-functionalized CdTe quantum dots in a simple one-pot method using mercaptopropionic acid (MPA) as a co-ligand, which binds to sites left free by the DNA. The DNA has three distinct domains: ‘binding’, ‘spacer’ and ‘specific binding’. The binding domain is made up of guanine bases and has a backbone of phosphorothioate linkages, rather than the usual



phosphodiester groups found in standard DNA. The simple replacement of oxygen with sulfur increases its binding affinity to cadmium and it preferentially binds to the nanoparticle surface — allowing the specific binding domain to remain free to bind with a complementary fragment from another quantum dot.

The size, and thus optical properties, of the free quantum dots were controlled

through reaction time, and their valency was controlled (between one and four) by altering the length of the DNA-binding domain (between twenty and five bases respectively). They were therefore able to create complex ternary structures (pictured) that have optical properties distinct from their components.

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