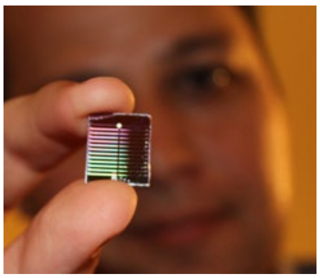
DIAGNOSTICS

▶ A test for chronic fatigue syndrome

Scientists have potentially identified a biomarker for chronic fatigue syndrome (CFS), sometimes called myalgic encephalomyelitis (ME), and used it to create a blood test for the disease. According to the Centers for Disease Control and Prevention, as many as 2.5 million people in the US have ME/CFS, which is characterized by overwhelming fatigue that's not improved by rest. There are currently no simple tests doctors can use to diagnose ME/CFS; instead, their diagnoses are based on symptomatic criteria. Researchers led by Rahim Esfandyarpour of the University of California, Irvine, and Ronald W. Davis of Stanford University hypothesized that they could use cell stress responses as the basis for a possible diagnostic. They collected red blood cells from 20 healthy volunteers and 20 people with CFS and exposed the cells to salt-induced osmotic stress forces. Then, using a nanoelectronic needle array, they measured how the blood cells in a salty solution impeded an electrical current. There was a distinct difference in the cells' electrical impedance. This suggests a diagnostic signature for the disease, although the authors are still working out the mechanism (*Proc. Natl. Acad. Sci. U.S.A.* 2019, DOI: 10.1073/pnas.1901274116). Esfandyarpour and Davis's team also applied a machine-learning algorithm to the results to improve the potential diagnostic. The researchers say the test they've developed could also be used to screen drugs for treating ME/CFS.—BETHANY HALFORD

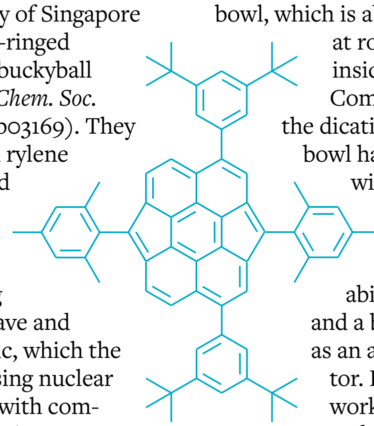


A diagnostic device for chronic fatigue syndrome, also known as myalgic encephalomyelitis

NANOMATERIALS

▶ Buckybowl is first of its kind

If you could smash a buckyball with a hammer, you might be left with a lot of little pieces. These buckyball fragments are called buckybowls, and their strained structures—and the laws of physics—mean making them is a lot harder than swinging a hammer. Now Jishan Wu and colleagues at the National University of Singapore have synthesized a seven-ringed fragment of a 70-carbon buckyball for the first time (*J. Am. Chem. Soc.* 2019, DOI: 10.1021/jacs.9b03169). They started with a five-ringed rylene molecule, then performed alkylation steps to add two five-membered rings and complete the buckybowl. The resulting molecule is slightly concave and dish-like. It's antiaromatic, which the researchers confirmed using nuclear magnetic resonance and with computer modeling. Aryl substituents maintain this electronic structure by preventing radical formation, and the bulk allowed the researchers to obtain a crystal structure. NMR revealed that the bowl, which is about 0.9 Å deep, oscillates at room temperature, flipping inside out and back again. Computer models showed that the dication form of the C_{70} buckybowl has an electronic structure with concentric rings of conjugated π orbitals. Wu says the molecule's small band gap and ability to act as both an acid and a base could make it useful as an ambipolar semiconductor. He says the group is now working to synthesize larger and deeper buckybowls.—SAM LEMONICK



2CP-Per-Ar

PERIODIC TABLE

Xenon-124 sets half-life record

The entire history of the universe is but a fleeting moment in time compared with the half-life of xenon-124. Clocking in at a staggering 1.8×10^{22} years, it's the longest half-life ever directly measured—and roughly 1 trillion times the universe's age (*Nature* 2019, DOI: 10.1038/s41586-019-1124-4). The result comes from the XENON1T detector at Italy's Gran Sasso National Laboratory (shown). Before it was decommissioned earlier this year, the detector contained 3.2 metric tons (t) of liquid xenon and was hunting for signs of dark matter—putative particles thought to account for huge amounts of unseen mass in the universe. Just 1 in every 1,000 xenon atoms is the ^{124}Xe isotope, which was predicted to decay into tellurium-124 by an inconceivably rare pathway called two-neutrino double electron capture. When two protons in the nucleus simultaneously capture two of the atom's own electrons, they transform into neutrons and release two neutrinos. The process also generates X-rays and electrons that could be picked up by XENON1T. The device identified 126 of these events in one year, enabling researchers to calculate the isotope's half-life. "It shows the unprecedented sensitivity of the detector," says Laura Baudis at the University of Zurich, who helps lead XENON1T. Although the experiment didn't find any dark matter, a more sensitive successor with 8.4 t of xenon is being built, and it may spot an even rarer decay pathway predicted for ^{136}Xe.—MARK PEPLOW, special to C&EN

CREDIT: XENON COLLABORATION (XENON1T); RAHIM ESFANDYARPOUR (DEVICE)