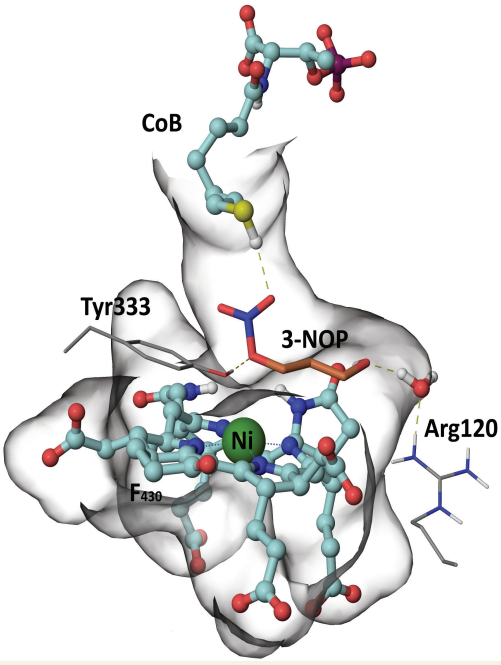
In this issue . . .

Inhibiting methane emissions from ruminants

Ruminants, such as cows, sheep, and goats, belch methane, contributing significantly to greenhouse gas emissions. The methane is produced by microorganisms in the ruminant digestive system and can contribute to the loss of up to 12% of the energy contained in feedstock. Evert Duin et al. (pp. 6172–6177) investigated the mode of action of 3-nitrooxypropanol (3-NOP), which was previously shown to decrease methane emission by ruminants when added to feed. The authors found that 3-NOP preferentially binds to the active site of methyl-coenzyme M reductase (MCR), an enzyme that catalyzes the methane-forming reaction of methanogenic microbes in the ruminant digestive system. Using purified MCR, the authors found that 3-NOP inactivates MCR at micromolar concentrations by oxidizing a nickel ion in the enzyme's active site. This reaction results in the production of nitrite in the active site, which also inactivates MCR at micromolar concentrations by oxidizing the active site nickel ion. In addition, at micromolar concentrations, 3-NOP inhibited the growth of several methane-producing microbes but not the growth of nonmethane-producing microbes. Due to the compound's specificity, 3-NOP could be developed into a feed supplement to reduce ruminant methane emissions, according to the authors. — S.R.



Active site of 3-NOP–bound MCR.

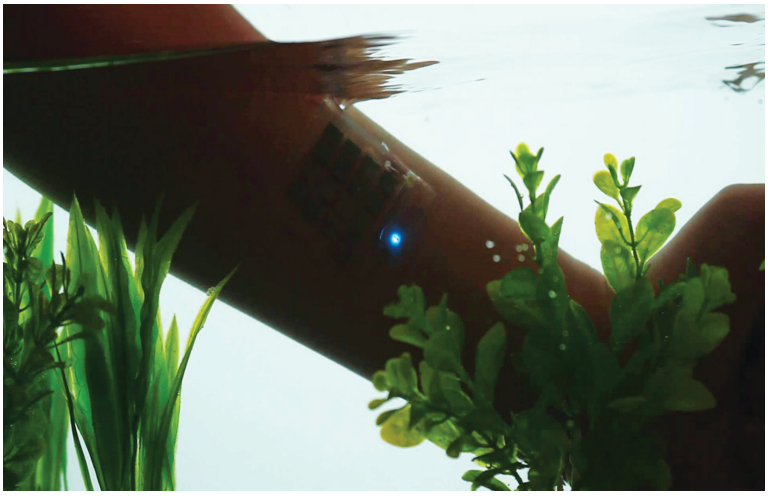
Lead isotopes and ancient Neapolitan plumbing

The impact of the Vesuvius volcanic eruption in AD 79 on the water supply of Naples and other nearby cities has been a matter of debate. Hugo Delile et al. (pp. 6148–6153) measured lead isotopic compositions of a well-dated sedimentary sequence from the excavated ancient harbor of Naples. The isotopic composition of leachates from the harbor sediments differed from those of lead native to the region, suggesting contamination from imported lead used in the ancient plumbing. The authors observed an abrupt change in isotopic composition in a sediment layer above that associated with the AD 79 eruption. This shift was estimated to postdate the eruption by approximately 15 years and suggests a switch to different pipes. The authors report that the Vesuvius eruption likely damaged the Neapolitan water supply network; nevertheless, the network continued to be used for another decade and a half while a new network was being constructed. Lead isotopes from later sediments suggested the steady expansion of the city's water supply system until the early fifth century AD, when multiple factors, such as invasions, natural disasters, and local administrative and economic collapse, led to its overall decline. The isotopic record further shows the ebb and flow of Neapolitan urban sprawl throughout the fifth and sixth centuries AD, according to the authors. — B.D.

Wearable batteries and solar cells

Establishing long-lived contact between wearable electronics and the skin requires thin, flexible, lightweight, and stretchable systems. Existing approaches for localized power generation and storage are often incompatible with these mechanical requirements. Jung Woo Lee et al. (pp. 6131–6136) report a

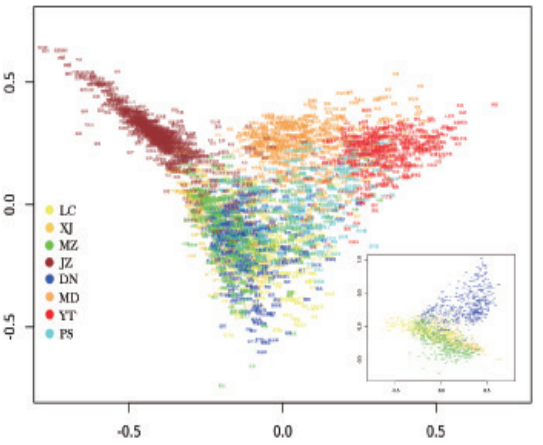
system for wearable photovoltaic power generation and storage using arrays of miniaturized rechargeable lithium-ion batteries and dual-junction solar cells. The components are electronically connected via flexible copper–polymer interconnects, mounted on a highly elastic silicone core, and enclosed within a silicone shell. The resulting system could stretch up to 30% without detectable loss in solar power generation. Batteries and solar cells could be further integrated by folding the system into a multilayer configuration without adversely affecting the mechanical properties. The authors demonstrated the use of these systems for continual logging and wireless transmission of body temperature data in a variety of realistic scenarios, such as monitoring skin temperature during physical exercise and bathing, and measuring temperature changes during breathing. By incorporating a temperature-activated LED into the system, the authors suggest that such a device might be useful for indicating excessively high or low temperatures. — B.D.



Soft, stretchable power storage device laminated onto the forearm and submerged in water.

Text mining algorithm deconstructs written Chinese

With applications from human health to artificial intelligence, text mining algorithms offer a means to scour and interpret digitized textual data. Researchers have focused on alphabet-based languages, such as English, which convey meaning via well-defined structural elements, including words and phrases. However, character-based languages, such as Chinese, pose a different challenge, namely parsing a hieroglyphic comprising around 3,000 commonly used characters undifferentiated by spaces or word boundaries. Ke Deng et al. (pp. 6154–6159) present an unsupervised algorithm dubbed top-down word discovery and segmentation (TopWORDS), which can identify and segment words and phrases from unstructured Chinese text. Unlike previous strategies that compose a final word list from a foundational set of one- or two-letter candidates, TopWORDS scours an initial oversized dictionary using statistical techniques to find the most likely location of word boundaries. Furthermore, TopWORDS output can be fed into automated context analysis programs with results that compare favorably with strategies requiring user supervision and guidance. The authors mined blog posts on the Chinese website Sina.com and demonstrate how TopWORDS preserves idioms and regular expressions. According to the authors, the method can be similarly applied to alphabet-based languages by treating each word as a separate character. — T.J.



Embedding representation of top words recovered from Sina.com.

Redefining health in older adults

Issued in 1946, the World Health Organization's definition of health includes not only the absence of illness but also evidence of well-being. However, 70 years later, most medical reimbursement codes consider only disease states, illustrating the meager attention paid to well-being in prevalent medical models. Martha McClintock et al. (pp. E3071–E3080) developed a comprehensive model of health that considers psychological health, mobility, sensory abilities, neuroimmune status, and health-related behaviors. The authors used data from the National Social Life, Health, and Aging Project, which surveyed 3,005 US seniors ages 57 to 85 who were living at home; the surveys were conducted in 2005 and 2010. Using a statistical technique to identify groups based on underlying variables, the authors categorized the respondents into health classes. Analysis of 19 variables associated with diseases mirrored a medical model approach and categorized respondents into two sets of health classes distinguished by diabetes. However, adding 35 additional variables addressing elements of mental health and sensory function altered the findings. This comprehensive health model sorted respondents into six health classes, from "robust" to "at-risk" categories. The model also identified two significant risk classes—individuals with broken

bones or poor mental health—that were obscured by the medical model. According to the authors, the comprehensive model was also more likely than the medical model to predict mortality or incapacitation in respondents. — T.H.D.

Biodiversity and fisheries production

Fish provide protein for more than 1 billion people worldwide, and fish biomass production constitutes a crucial ecosystem service. J. Emmett Duffy et al. (pp. 6230–6235) used the Reef Life Survey's database of more than 4,500 fish surveys from reefs around the world to compare the effects of biodiversity and environmental factors on global reef fish biomass. The authors found that biodiversity, measured by the number of species and the diversity of functional traits within a community, was a strong predictor of fish biomass, second only to mean sea-surface temperature (SST). Further, biodiversity was as strong a predictor of fish biomass as human population density. Biodiversity also enhanced stability of fish biomass production: fish biomass generally declined with climate variability, measured by SST range, but this decline was significantly weaker in species-rich communities than in communities with low species richness. In low-richness communities, biomass declined with increasing mean SST above 20 °C, but remained stable above 20 °C in species-rich communities. According to the authors, the findings suggest that high biodiversity might provide a buffer against the effects of climate change, and that conserving biodiversity could support increased productivity and resilience of reef fisheries. — B.D.

Diverse reef fishes, Raja Ampat, Indonesia.