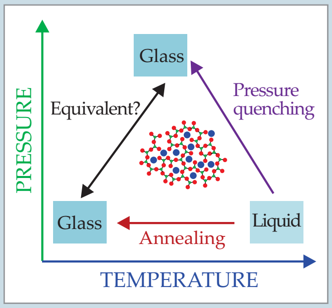
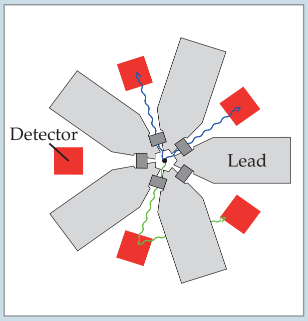
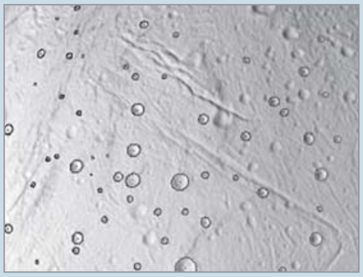


distances between nearest neighbors, but in the annealed glass the bond angles have a narrower distribution, which leads to greater short-range order. On the other hand, pressure quenching has a stronger influence on the medium-range order—the repetition distances for typical atomic arrangements—which has much less influence on the material's hardness. Thus, as shown schematically here, thermal annealing and pressure-quenching treatments can be thought of as independent degrees of freedom, comparable to composition, in designing new industrial glasses. (M. M. Smedskjaer et al., *J. Chem. Phys.* **143**, 164505, 2015.) —SGB

A two-in-a-million double-photon nuclear decay. In her 1930 dissertation, Maria Goeppert Mayer used perturbation theory to derive the probability for an atom to change its electronic state by absorbing or emitting two photons of appropriate combined energy. Such two-photon processes are today being routinely used in spectroscopy and other applications. Although atomic nuclei can undergo similar transitions involving two gamma-ray photons, they are usually overwhelmed by single-gamma transitions. Two-gamma decays have been observed only for three isotopes in which quantum mechanics forbids single-gamma decay. Now a team at the Darmstadt University of Technology in Germany reports the first clear observation of two-photon emission from excited nuclei for which the single-photon decay *is* allowed—and 5×10^5 more likely—a situation the researchers call competitive double-gamma decay. As sketched here, the researchers deployed five detectors (red) to record pairs of gammas (blue) emitted in the two-photon decay of excited barium-137 nuclei. However, a lone gamma (green) from the copious single-photon decays might deposit only part of its energy in a detector; so to prevent it from caroming into a second detector and mimicking a double-gamma decay, the experimenters placed lead shields (gray) between the detectors. Moreover, the detectors' subnanosecond time resolution captured the additional flight time of the scattered gamma. Careful statistical analysis took account of the other significant background source: two nearly simultaneous yet independent single-gamma decays. The result: distinct two-gamma decay signatures. What is more, the researchers could determine the dominant perturbation-theory contributions, which depend on details of nuclear structure. (C. Walz et al., *Nature* **526**, 406, 2015.) —RJF



Enceladus's subsurface ocean wraps the moon. A decade ago the *Cassini* orbiter spotted gas and ice spewing from the south polar region of Saturn's moon Enceladus. Subsequent investigations revealed that the ice is salty, a result indicating that the ice originated from a liquid ocean between Enceladus's frozen surface and its silicate core. Now Peter Thomas (Cornell University) and his colleagues have analyzed more than seven years of *Cassini* surface observations and shown that the ocean is not localized at the polar region of Enceladus; rather, it is global. The figure shows some of the several hundred surface features tracked by the researchers. To first approximation, Enceladus, like our Moon, presents one face to its planet. But because Enceladus is a bit out of round, Saturn torques the satellite and induces a so-called libration, a wobble in the Enceladean hemisphere visible from Saturn. For a localized ocean, the icy surface of Enceladus and its core would be physically connected; the entire mass of the moon would respond to the torque and the libration would be small. A global ocean, on the other hand, would act like a lubricant, so the surface and core slide past each other; only the surface would respond to Saturn's torquing and the wobble could be relatively big. Thomas and colleagues' analysis yielded the large libration consistent with a global ocean. Tidal heating can provide the energy to liquefy subsurface ice on Enceladus. But just how tidal heating can maintain the moon's global ocean remains an unanswered question. (P. C. Thomas et al., *Icarus* **264**, 37, 2016.) —SKB



A study in contrasts for inhibiting surface frost. Whether on airplane wings or old refrigerators, frost forms when water droplets nucleate on a surface, grow, coalesce, and finally freeze. Although the interactions between water and surfaces can seem simple, they are remarkably complex (see, for instance, "The first wetting layer on a solid" by Peter Feibelman, PHYSICS TODAY, February 2010, page 34, and the Quick Study by Laurent Courbin and Howard Stone, PHYSICS TODAY, February 2007, page 84). To slow down freezing and decrease freezing temperatures, scientists have explored nanopatterned or superhydrophobic surfaces that delay nucleation, for example, or increase droplet mobility. Now Amy Betz and colleagues at Kansas State University show that so-called biphilic surfaces that combine hydrophilic and hydrophobic regions can lower freezing temperatures even further, to as much as −6 °C. The team's biphilic samples resemble slices of Swiss cheese on crackers: A hydrophilic substrate shows through regularly spaced holes (200 μm for some samples, 25 μm for others) in a self-assembled monolayer of a hydrophobic polymer. Placed inside a chamber kept at atmospheric pressure, 295 K, and 30%, 60%, or 75% relative humidity (RH), each sample was cooled in 0.5-K steps, with up to 3 hours between steps, until all the visible water droplets on it froze, like those seen here. Freezing was most inhibited at 60% RH. On all the surfaces, the initial droplets were about 5 μm across. But the researchers found significant differences in the surfaces' average frozen-droplet size and density and in the time it took them to freeze; those differences must be due to how the droplets grow and merge. The researchers explain that the behavior is consistent with the energetics of coalescence. (A. S. Van Dyke et al., *Appl. Phys. Lett.* **107**, 141602, 2015.) —RJF