

edited by Gilbert Chin



Kettle Lake.

GEOLOGY

Plains on Fire

Before elaborate programs of fire suppression were instituted in North America in the 20th century, wildfires occurred frequently and were critical contributors to the health and maintenance of many different ecosystems. Abundant evidence for a link between fires and

climate exists for many forested regions, but less attention has been paid to nonboreal environments. The grasslands of the Northern Great Plains, which have replaced the extensive spruce forests that stood there at the start of the Holocene, are one such system.

In order to establish how drought and fire might be related in this region, Brown *et al.* constructed a 4500-year-long record of charcoal, grass pollen, and soil carbonate at Kettle Lake in North Dakota. They find that charcoal production was highest during moist intervals, when grass cover (fuel) was plentiful, and that fires did not happen at regular intervals. Spectral analysis of the data showed that for much of the late Holocene, fires recurred in cycles with a period of around 160 years, but secular trends, including any evidence of the effects of anthropogenic warming, are more difficult to detect. — HJS

Proc. Natl. Acad. Sci. U.S.A. **102**, 8865 (2005).

CHEMISTRY

Safer Sodium

Metallic sodium and potassium, as well as their alloys, are useful for their potency in chemical reduction reactions. However, their instability when exposed to oxygen is inconvenient, and their highly exothermic reaction with water is a severe fire hazard in the laboratory.

Dye *et al.* have addressed this problem by mixing the metals with silica gel. Liquid Na-K alloy combines with silica at room temperature, producing a black powder that remains air-sensitive but is easily handled under nitrogen. Heating the powder to 150°C (or heating a pure Na/silica mixture to 165°C) yields a new product, stable for months, that retains much of its reducing capacity even on exposure to dry oxygen. This so-called stage I powder can be packed in columns and used for reductions or dehalogenative couplings of eluted aromatics. Further heating of the Na-stage I powder to 400°C gives a slightly less powerful stage II reducing agent that can be handled in humid air and used for drying organic solvents or for controlled reaction with water to generate small quantities of hydrogen. Preliminary experiments suggest that stage II formation involves chemical decomposition of the silica to produce Na₄Si₄ particles. — JSY

J. Am. Chem. Soc. **10.1021/ja051786+** (2005).

PHYSIOLOGY

A Scuba Gel

In the phylogenetically ancient eumetazoan jellyfish, between the endoderm and ectoderm lies the mesoglea, a noncellular gelatinous mix of

IMMUNOLOGY

Nippy Inoculation

For a vaccine to generate protective immunity at a level comparable to that produced by an infection, one or more secondary booster shots over an extended period of time may be required. Thus, finding ways by which the initially primed memory T cells might be more efficiently bolstered could help to increase vaccine efficacy.

Badovinac *et al.* show that mice vaccinated with dendritic cells that have been coated with peptides derived from the bacterium *Listeria monocytogenes* could mobilize a memory CD8⁺ T cell response to a booster challenge considerably faster than mice given an attenuated bacteria vaccine. Furthermore, the dendritic cell-vaccinated mice also showed significantly greater resistance to infectious bacteria, consistent with an increased level of protective immunity. Vigorous memory responses were also generated to a range of other booster immunizations, including those from a noninfectious source, and were

apparent even toward weak antigens. Vaccination with coated dendritic cells in this setting was at its most efficacious when inflammatory signals were minimal, which appeared to accelerate the rate at which CD8⁺ T cells acquired a memory phenotype during the priming phase. — JSJ

Nat. Med. **10.1038/nm1257** (2005).

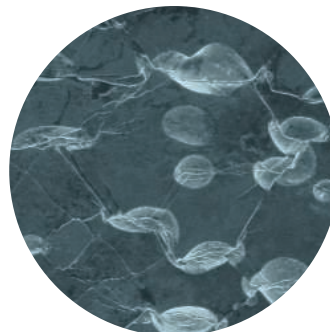
MATERIALS SCIENCE

Pores for Strength

It is now possible to make bulk metallic glasses (BMGs) from a wide range of alloy compositions and to fabricate parts where the minimum dimension is at least a few millimeters. In comparison to the corresponding crystalline alloys, BMGs are almost twice as strong. Their downfall is a lack of plastic strain, which leads to softening and abrupt failure associated with shear bands, even under compression. Although they can be rendered more ductile by including a dispersed crystalline phase, this reduces the yield strength.

Wada *et al.* used four distinct hydrogenation treatments to

create BMG rods with porosities between 0 and 4%. Compressive tests showed only a small decrease in the Young's modulus (about 10%), but with a strain at rupture as high as 18% and a significant increase in the rupture energy, which is the total energy under the stress-strain curve before failure. Structural analysis of the fractured samples showed that the



Scanning electron micrograph showing pores and shear bands.

pores acted as stress concentrators for the shear bands, causing an increase in the shear banding as the material deformed, thus increasing its toughness. — MSL

Appl. Phys. Lett. **86**, 251907 (2005).