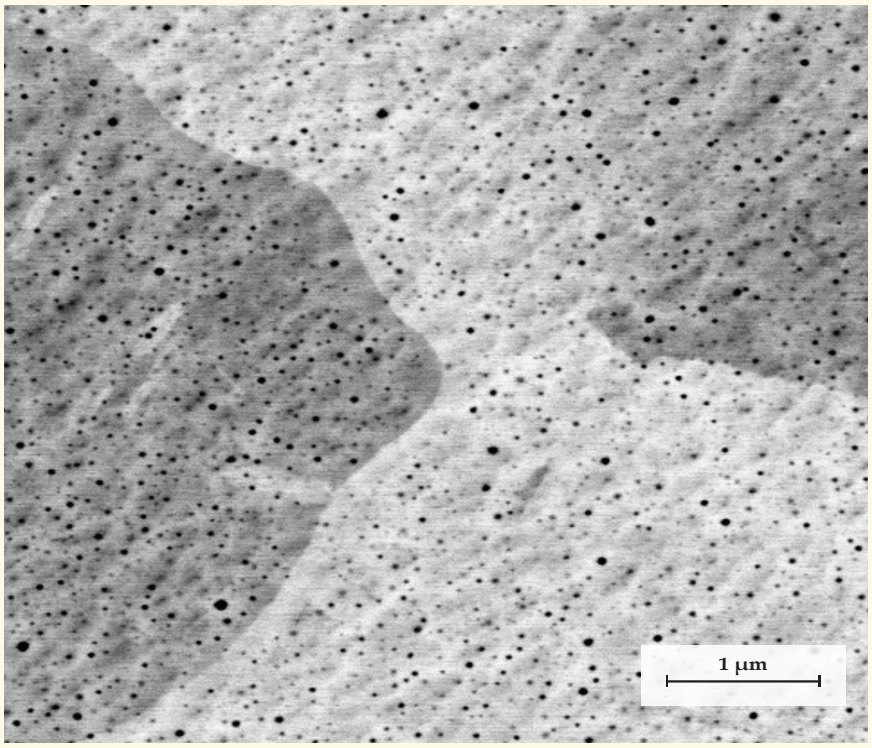
Perforating gold can make it stronger

Often considered a nuisance, voids in a metal may improve certain mechanical properties if they are small and uniformly distributed.

Poking holes in a metal may not seem like a great way to strengthen it. Small voids can rapidly expand, and a metal peppered with large fissures isn't useful for many applications. Metal suppliers and industrial users often put considerable effort into preventing the formation of internal voids. Yet a new study of gold suggests that permeating the 3D structure of a metal with minute holes can augment the metal's strength. The findings lend support to predictions that sufficiently small voids would enhance metals' desirable mechanical properties.

Hai-Jun Jin (Chinese Academy of Sciences) and colleagues fashioned holey gold by removing the silver from a gold–silver alloy via a corrosion process. The reaction yielded gold that was weakened by a network of nanosized channels. To bolster the fragile metal, the researchers compressed and heated the samples. Beyond a threshold material density, the channels closed up to form an array of isolated, evenly spaced voids of roughly equal size. The researchers tuned both the size of the voids, which ranged from 18 to 180 nm, and the void distribution by adjusting the corrosion reaction, the degree of compression, and the annealing temperature.



HOLES MEASURING ABOUT 18 NM ACROSS permeate a sample of gold in this scanning electron micrograph. (Courtesy of Jia-Ji Chen.)

Jin and colleagues then took their millimeters-wide samples and stretched them to measure stress and strain. The smaller the embedded holes, the stronger the metal: The gold with 18 nm voids withstood twice the stress before deforming than the samples of bulk gold. The researchers also found that the hole-ridden samples were just as able to be stretched without fracturing as conventional gold.

Electron micrographs of the samples pre- and post-stretching indicate that the size of the holes is central to their beneficial influence. Unlike the voids that are the scourge of metal suppliers, the ones in the Jin team's samples are two or three orders of magnitude smaller than the metal's grain size, so they are unlikely to be the source of fractures. They also seem to impede the progress of linear defects that propagate through the metal.

Jin and his team plan to try perforating other pure and alloyed metals, including some, such as copper, that are used more frequently than gold for structural applications. (J.-J. Chen et al., *Science* **385**, 629, 2024.)

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Sizes of tropical glaciers reach historic lows

New measurements of radioactive isotopes provide evidence for the retreat of Andean glaciers since the end of the last ice age.

Most glaciers worldwide are retreating because of climate change. To put the current retreat into perspective, researchers have conducted surveys that estimate historical glacial extent. They have found that many glaciers, including many high-altitude mountain glaciers, are not as small as they were in the past. By the early Holocene, roughly 12 000 years ago, Earth had come out of its last ice age, and variations in the planet's orbit caused warmer summers and, consequently, smaller glaciers.

Tropical glaciers today, located in mountainous regions, appear to be decreasing in size more than glaciers in other regions. New results by Andrew Gorin of the University of California, Berkeley, and colleagues show that several glaciers in South America—where nearly all tropical glaciers are found—have retreated to a minimum extent not seen during any other time since the early Holocene, when humans were just starting to domesticate plants and animals for agriculture.