Scientists discover metals that defy the deep freeze at –424°F

Prelims- *Current events of National and International Importance*

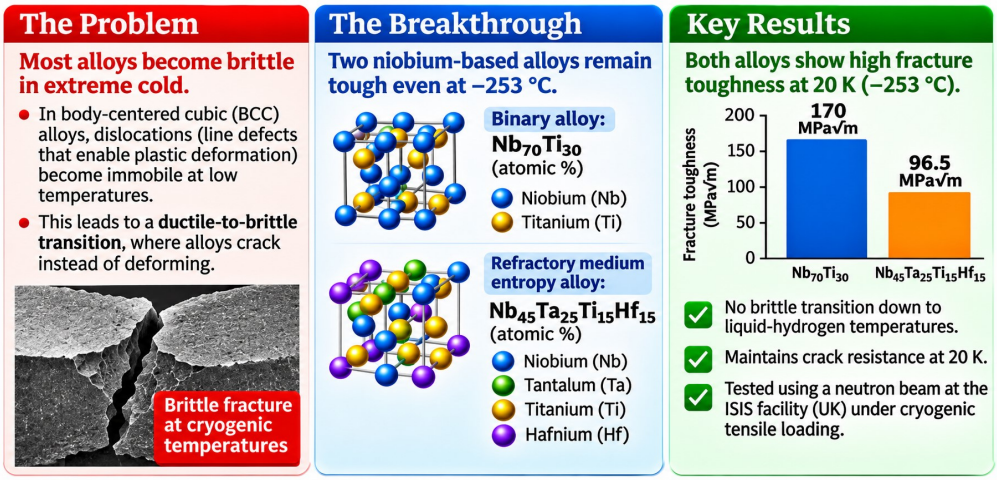
An international team of researchers from the University of California, Berkeley, Lawrence Berkeley National Laboratory, and the University of Oxford discovered that experimental niobium–titanium–based metal alloys can stay tough, flexible, and crack–resistant at an extreme cryogenic temperature of –424°F (–253°C or 20 Kelvin).

The Problem with Normal Metals in Extreme Cold

- **Body-Centered Cubic (BCC) Metals-** Metals like iron, tungsten, and chromium have a specific internal crystal layout called a BCC structure.
- **The Brittle Trap-** Normally, when metals face stress, tiny line–like defects called *dislocations* move around to let the metal bend instead of breaking.
- **Freezing in Place-** As temperatures drop toward absolute zero, these dislocations freeze solid. Without the ability to flex, the metal loses its ductility and shatters like glass under pressure (known as the *ductile–to–brittle transition*).

How the New Alloys Defy the Freeze

- Instead of relying on traditional dislocation movement, the newly studied niobium–titanium alloys **switch their deformation strategy** when subjected to deep–freeze conditions–
- **Nanoscale Twinning-** Tiny regions of the metal's crystal structure reorganize into mirror–image orientations.
- **Phase Transformations-** This twinning couples with a localized shift in the crystal arrangement.
- **New Stress Routes –** When these structures hit neighboring crystal boundaries, they spark fresh defects that let the metal keep absorbing stress and deforming rather than snapping.
- **Potential Uses**
- Because these alloys maintain damage tolerance at temperatures close to absolute zero, they could transform engineering for extreme environments:
- **Aerospace and Space Exploration-** Building structural components or machinery that must survive the harsh cold of deep space.
- **Clean Energy and Transport-** Safely storing and handling cryogenic liquids like liquid hydrogen.



Reference

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