

Gold beyond its Melting Point remain Solid

Prelims: Current events of national and international importance

Why in News?

Recent observations of Gold superheated far beyond its melting point can remain solid, suggesting that scientists should develop materials that tolerate extreme environments.

- **Publication** - The research is published in the journal "Nature".
- **Focus** - It investigates the phenomenon of superheating in gold when heated rapidly.
- **Key concepts**
 - **Superheating** - It occurs when a solid remains solid at temperatures exceeding its melting point.
 - **Role of entropy** - Entropy measures disorder, which increases as a substance is heated.

***Entropy catastrophe** is an underlying limit based on thermodynamic principles that suggests solids should not maintain their state beyond certain temperatures.*

- **Historical context** -
 - **Kauzmann paradox (1948)** - Walter Kauzmann found that cooled liquids could have lower entropy than their crystalline forms.
 - **Fecht-Johnson findings (1980's)** - Hans-Jörg Fecht and William Johnson discovered that superheated solids could possess greater entropy than liquids, defying established thermodynamic expectations.
 - **Outcomes** - Both are "catastrophic" because of the second law of thermodynamics, which states that in an isolated system evolving spontaneously, the entropy can't decrease over time.
- **Recent findings** - Researchers utilized powerful laser pulses for rapid heating of gold films approximately 50 nm thick.
- **Duration of laser pulses** - Each laser pulse lasted 45 femtoseconds. **Measurement technique** - High-resolution inelastic X-ray scattering was employed to ascertain the temperature of gold atoms.
- **Results** - Superheating limit observed that solid gold was found to remain solid at **14 times** its melting point for a few trillionths of a second.
- **Atomic structure confirmation** - X-ray diffraction patterns showed the atoms maintained an organized crystalline structure.
- **Implications** -
 - **Material design importance** - Insights into superheating can help engineers develop materials for extreme environments.

- **Technological advances** - The ability to conduct this research was made possible by recent technological advancements.

Reference

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