Scientists Stunned by Self-Healing Metal Discovery

Description

Label this phenomenon as 'an unexpected occurrence!' In a groundbreaking experiment, researchers witnessed a metal exhibiting self-healing properties. Should this process be thoroughly comprehended and harnessed, we may be on the brink of a transformative epoch in engineering.

A study released the previous year by a collaborative team from Sandia National Laboratories and Texas A&M University examined the durability of a metal, employing an innovative electron microscope technique that subjected the material to stress cycles at a staggering rate of 200 pulls per second.

The team closely monitored the self-healing phenomenon at an exceptionally minute scale within a 40-nanometer-thick sample of platinum, carefully suspended in a vacuum.

The fractures resulting from the aforementioned strain are categorized as fatigue damage, which emerges from repeated stress and motion that ultimately leads to microscopic fissures, compromising the integrity of machines or infrastructure.

Remarkably, after approximately 40 minutes of observation, the crack in the platinum began to fuse back together, healing before it resumed cracking in an alternate direction.

Metal diagram
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Illustration of applying pulling forces (red arrows) leading to a crack that healed (green) in platinum metal. (Dan Thompson/Sandia National Laboratories)

"Witnessing this firsthand was truly astonishing," stated materials scientist Brad Boyce from Sandia National Laboratories, upon revealing the findings.

"We certainly did not anticipate this outcome. What we have established is that metals possess an intrinsic, natural capacity to mend themselves, at least in instances of fatigue damage at the nanoscale."

While we currently understand the precise conditions under which this occurs, the implications are vast. The potential cost and labor savings in the maintenance of infrastructure—from bridges to machinery to consumer electronics—are profound if metals can indeed self-repair.

Though this observation marks an unprecedented milestone, it is not entirely unexpected. Back in 2013, Texas A&M University's materials scientist Michael Demkowicz conducted a study forecasting the possibility of such nano-scale crack healing, driven by the minute crystalline structures within metals responding to stress by shifting their boundaries appropriately.

Demkowicz also contributed to this recent study, utilizing advanced computer models to validate that his theories regarding the self-healing behavior of metals at the nanoscale indeed align with the observed phenomena.

Images showing the process of healing

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In-depth observations of the healing process captured through dynamic video analysis. (Barr et al., *Nature*, 2023)

Another promising aspect of this research is that the automatic healing took place at room temperature. Typically, metals require significant heating to alter their structural properties; however, this experiment occurred under a vacuum. The capacity for similar processes to occur in standard metals in typical environments remains to be explored.

A plausible explanation may involve cold welding, a phenomenon that can transpire at ambient temperatures when metal surfaces are drawn sufficiently close for their atoms to interlock.

Generally, thin air layers or other contaminants hinder this interaction; however, in environments such as the vacuum of space, pure metals can be placed in proximity to one another, allowing them to bond.

"It is my aspiration that this discovery spurs materials researchers to recognize that, under certain conditions, materials might exhibit behaviors beyond our prior expectations," expressed Demkowicz.

This research was published in *Nature*.

An earlier version of this article was disseminated in July 2023.

Vocabulary List:

1. **Phenomenon** /fəˈnɑːmənɑːn/ (noun): An observable fact or event especially one that is remarkable or unusual.
2. **Self-healing** /ˌselfˈhiːlɪŋ/ (adjective): Having the ability to repair itself automatically after damage.
3. **Durability** /ˌdʊrəˈbɪlɪti/ (noun): The ability to withstand wear pressure or damage.
4. **Phenomena** /fɪˈnɒmɪnə/ (noun): Plural of phenomenon; observable facts or events.
5. **Fatigue** /fəˈtiːg/ (noun): Weakness in materials caused by repeated stress and motion.
6. **Microscopic** /ˌmaɪkrəˈskɒpɪk/ (adjective): So small as to be visible only with a microscope.

Comprehension Questions

Multiple Choice

1. What phenomenon was labeled as "an unexpected occurrence" in the text?

   Option: Metal self-healing properties
   Option: Fatigue damage in metals
   Option: Use of electron microscope technique
   Option: Metallic construction materials

2. Which research institutions were involved in the study of metal self-healing properties?

   Option: Sandia National Laboratories and MIT
   Option: Texas A&M University and NASA
   Option: Sandia National Laboratories and Texas A&M University
   Option: Harvard University and Stanford University

3. What is the term used to describe the fractures resulting from repeated stress and motion in metals?

   Option: Microscopic fissures

Option: Industrial damage
Option: Macroscopic fractures
Option: Structural weakening

4. In what journal was the research on metal self-healing properties published?

Option: Science
Option: Nature
Option: Engineering Today
Option: Materials Science Review

5. Which scientist conducted a study in 2013 forecasting nano-scale crack healing in metals?

Option: Michael Demkowicz
Option: Brad Boyce
Option: Dan Thompson
Option: John Smith

6. At what temperature did the automatic healing of metals occur in the experiment?

Option: Sub-zero temperatures
Option: Room temperature
Option: High heat conditions
Option: Vacuum temperatures

True-False

7. Metal self-healing properties were entirely unexpected in the research.

8. Cold welding is a phenomenon that occurs at extremely high temperatures in metals.

9. Metals typically require significant heating to alter their structural properties.

10. Michael Demkowicz only contributed to the 2013 study but was not part of the recent research on metal self-healing properties.

11. The research on metal self-healing properties was disseminated in May 2023.

12. The materials research community is not urged to consider unexpected material behaviors from this discovery.

Gap-Fill

13. The crack in the platinum began to fuse back together after approximately _____ minutes of observation.

14. Michael Demkowicz conducted a study forecasting nano-scale crack healing in metals back in _____.

15. The potential cost and labor savings in the maintenance of infrastructure are profound if metals can indeed _____.

16. Cold welding can occur at ambient temperatures when metal surfaces are drawn sufficiently close for their _____ to interlock.

17. Under certain conditions, materials might exhibit behaviors beyond our prior _____.

18. A plausible explanation for the automatic healing of metals may involve the phenomenon known as _____ welding.

Answer

Multiple Choice: 1. Metal self-healing properties 2. Sandia National Laboratories and Texas A&M University 3. Microscopic fissures 4. Nature 5. Michael Demkowicz 6. Room temperature
True-False: 7. False 8. False 9. True 10. False 11. False 12. False
Gap-Fill: 13. 40 14. 2013 15. self-repair 16. atoms 17. expectations 18. cold

Vocabulary quizzes

Multiple Choice (Select the Correct answer for each question.)

1. Which term refers to the process of water falling to the ground from the atmosphere?
   Option: Phenomena
   Option: Anticipate

Option: Exploit
Option: Precipitation

2. What does the term "proximity" mean?

Option: Trajectory
Option: Pervasive
Option: Proximity
Option: Extravagant

3. Which term describes the ability to withstand prolonged stress or activity?

Option: Manifest
Option: Endurance
Option: Severity
Option: Propensity

4. Which term relates to mental processes such as thinking learning and remembering?

Option: Cognitive
Option: Plethora
Option: Acuity
Option: Interconnectedness

5. What is the enzyme responsible for maintaining the length of telomeres?

Option: Advocate
Option: Telomerase
Option: Self-healing
Option: Durability

6. Which term refers to the feeling of tiredness or exhaustion?

Option: Phenomenon
Option: Fatigue
Option: Microscopic
Option: Exploit

7. What does the term "severity" imply?

Option: Severity
Option: Anticipate
Option: Trajectory
Option: Proactive

8. To alleviate means to:

Option: Alleviate
Option: Advocate
Option: Extravagant

Option: Endurance

9. What does the term "propensity" refer to?

Option: Manifest
Option: Propensity
Option: Pervasive
Option: Proximity

10. Which term means to display or show clearly?

Option: Cognitive
Option: Manifest
Option: Interconnectedness
Option: Endurance

Gap-Fill (Fill in the blanks with the correct word from the vocabulary list.)

11. This year has seen a _____ increase in online shopping due to the pandemic.

12. The theory of _____ suggests that everything is connected in some way.

13. She threw an _____ birthday party with fireworks and live music.

14. It is better to be _____ in preventing problems rather than dealing with them after they occur.

15. The buffet offered a _____ of options from salads to desserts.

16. Taking a pain reliever can help _____ headache symptoms.

17. The storm caused _____ damage to buildings and vehicles.

18. The organization works to _____ for animal rights and welfare.

19. Marathon runners need great _____ to complete a 26.2-mile race.

20. _____ is an enzyme that adds DNA sequence repeats to the ends of chromosomes.

Matching Sentences (Match each definition to the correct word from the vocabulary list.)

21. occur when one celestial body passes in front of another obscuring it from view.

22. Pilots need to perform quick and precise when flying in challenging conditions.
23. Being able to potential issues can help in avoiding last-minute problems.
24. The influence of social media is in modern society affecting people of all ages.
25. Certain materials have the ability to undergo processes to repair cracks and damage.
26. Products that are known for their are more likely to last longer and withstand wear and tear.
27. A solar eclipse is a natural that captivates people around the world.
28. organisms play a crucial role in various ecosystems despite their small size.
29. The of a rocket determines its path through space and back to Earth.
30. Some companies may try to legal loopholes for their benefit which can lead to ethical issues.

Answer

Multiple Choice: 1. Precipitation 2. Proximity 3. Endurance 4. Cognitive 5. Telomerase 6. Fatigue 7. Severity 8. Alleviate 9. Propensity 10. Manifest
Gap-Fill: 11. Phenomenal 12. Interconnectedness 13. Extravagant 14. Proactive 15. Plethora 16. Alleviate 17. Severe 18. Advocate 19. Endurance 20. Telomerase
Matching sentence: 1. Occultations 2. Maneuvers 3. Anticipate 4. Pervasive 5. Self-healing 6. Durability 7. Phenomenon 8. Microscopic 9. Trajectory 10. Exploit

CATEGORY

1. Sci/Tech - LEVEL5

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