Revolutionary Material Bends Light Around Corners

Description


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A New Material Can Bend Light

University of Glasgow

Researchers have unveiled a remarkable technique allowing light to curve around obstacles, mimicking the scattering of sunlight by clouds. This novel approach to light manipulation holds promise for significant advancements in fields such as medical imaging, electronics cooling, and even nuclear reactor engineering.

Daniele Faccio and his team at the University of Glasgow, UK, expressed astonishment that this form of light scattering had not been previously acknowledged. Drawing parallels to clouds, snow, and other white substances, they observed that when photons strike the surface of such materials, they scatter in all directions, with minimal penetration and frequent reflection back out. For example, sunlight striking a towering cumulonimbus cloud reflects off its upper layers, rendering it brightly white, while the base appears gray due to insufficient light penetration.

“The photons bounce around, struggling to penetrate, ultimately reflecting back because they cannot enter the material. This phenomenon is light scattering,” explains Faccio.

To emulate this effect, the researchers employed 3D printing to create opaque white structures interspersed with narrow, clear resin tunnels. When illuminated, light traverses these channels and scatters—similar to light interacting with snow or clouds. However, instead of dispersing erratically, the photons are guided back towards the resin tunnels by the surrounding opaque material, enabling the creation of objects that direct light in a controlled manner.

These 3D-printed creations exhibit functionality akin to fiber optic cables, which transmit light along their lengths, yet they operate based on fundamentally divergent principles. Fiber optic cables rely on total internal reflection; when photons reach a boundary with a lower refractive index, they reflect back internally, facilitating long-distance light transmission, including at angles.

The researchers assert that their innovative material enhances light transmission by over two orders of magnitude compared to solid counterparts lacking the transparent channels, in addition to accommodating curves. Although its efficiency may not rival that of fiber optics, the simplicity and cost-effectiveness of this approach render it attractive.

This light-bending technique could exploit pre-existing translucent conduits within biological systems, such as tendons and cerebrospinal fluid, presenting novel avenues for medical imaging. Faccio posits that this same principle can also be applied to direct thermal energy and neutrons, potentially benefiting engineering applications such as cooling technologies and nuclear reactors.

“It was not apparent that this would yield results, and we were genuinely astonished,” remarks Faccio. He speculates that such a phenomenon could have been uncovered decades, if not centuries, ago. “It’s not as if we’ve derived an obscure equation with extraordinary properties.”

Topics:

Vocabulary List:

1. **Technique** /tɛkˈniːk/ (noun): A method or way of doing something especially in a skillful way.
2. **Phenomenon** /fɪˈnɒməˌnɒn/ (noun): An observable event or occurrence.
3. **Transmission** /trænzˈmɪʃən/ (noun): The act or process of sending or conveying something from one place to another.
4. **Scattering** /ˈskætərɪŋ/ (noun): The process of spreading or dispersing something in various directions.
5. **Opaqueness** /oʊˈpeɪk.nəs/ (noun): The quality of being difficult to see through; not transparent.
6. **Innovative** /ˈɪnəˌveɪtɪv/ (adjective): Featuring new methods or ideas; original and creative in thinking.

Comprehension Questions

Multiple Choice

1. Who expressed astonishment that this form of light scattering had not been previously acknowledged?

Option: Daniele Faccio and his team at the University of Glasgow
Option: Researchers at MIT
Option: Scientists at Harvard University
Option: Physicists at Stanford University

2. What technique was employed by the researchers to create opaque white structures interspersed with narrow, clear resin tunnels?

Option: 3D printing
Option: Nanotechnology
Option: Bioprinting
Option: Laser cutting

3. According to the researchers, their innovative material enhances light transmission by over how many orders of magnitude compared to solid counterparts lacking transparent channels?

Option: One
Option: Two
Option: Three
Option: Four

4. What biological systems could the light-bending technique exploit to present novel avenues for medical

imaging?

Option: Tendons and cerebrospinal fluid
Option: Lungs and liver
Option: Heart and kidneys
Option: Brain and spinal cord

5. What principle can be applied to direct thermal energy and neutrons according to Faccio?

Option: Light-bending technique
Option: Fiber optic cables
Option: Total internal reflection
Option: Quantum entanglement

6. Fiber optic cables rely on which principle for transmitting light along their lengths?

Option: Total internal reflection
Option: Refraction
Option: Optical interference
Option: Absorption

True-False

7. The researchers claim that this light-bending technique is as efficient as fiber optics.

8. Fiber optic cables operate based on fundamentally divergent principles compared to the 3D-printed creations.

9. The researchers speculate that their phenomenon could have been uncovered centuries ago.

10. The researchers at the University of Glasgow were not surprised by the results of their light-bending technique.

11. The innovative material developed by the researchers is not cost-effective.

12. The light-bending technique can be applied to engineering applications like cooling technologies and nuclear reactors.

Gap-Fill

13. The researchers employed 3D printing to create opaque white structures interspersed with narrow, clear resin tunnels to emulate the effect of light scattering seen in _____ or clouds.

14. Fiber optic cables transmit light along their lengths based on _____ reflection.

15. According to the researchers, their innovative material enhances light transmission by over two orders of magnitude compared to solid counterparts lacking the transparent _____.

16. The light-bending technique could exploit pre-existing translucent conduits within biological systems such as tendons and _____ fluid.

17. The simplicity and cost-effectiveness of the researchers' approach make it an attractive alternative to traditional _____ optics.

18. The researchers believe that their light-bending technique can be applied to direct _____ energy and neutrons.

Answer

Multiple Choice: 1. Daniele Faccio and his team at the University of Glasgow 2. 3D printing 3. Two 4. Tendons and cerebrospinal fluid 5. Light-bending technique 6. Total internal reflection
True-False: 7. False 8. True 9. True 10. False 11. False 12. True
Gap-Fill: 13. snow 14. total internal 15. channels 16. cerebrospinal 17. fiber 18. thermal

Vocabulary quizzes

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

1. Which word best describes a situation that is uncertain and risky?

Option: Entrust
Option: Precarious
Option: Regulatory
Option: Innovative

2. Which term refers to the improper or harmful use of something?

Option: Accountable
Option: Misuse
Option: Efficacy
Option: Assurances

3. What word is used to describe what remains after something is removed?

Option: Residual
Option: Scattering
Option: Vulnerability
Option: Innovative

4. What term refers to the rivalry between individuals or groups for a common goal?

Option: Entrust
Option: Competition
Option: Assurances
Option: Amalgamate

5. Which word describes the process of preparing someone for a specific role or task?

Option: Offence
Option: Grooming
Option: Transmission
Option: Opaqueness

6. What term is used to express worries or anxieties about something?

Option: Regulator
Option: Concerns
Option: Semipermeable
Option: Entrust

7. Which word describes the basic physical and organizational structures needed for the operation of a society or enterprise?

Option: Innovative
Option: Opaqueness
Option: Infrastructure
Option: Regulatory

8. What term is used to describe promises or guarantees intended to provide confidence?

Option: Offence
Option: Assurances
Option: Cessation
Option: Efficacy

9. Which word refers to feelings of anxiety or unease about something uncertain?

Option: Technique
Option: Apprehensions
Option: Merger
Option: Accountable

10. What term describes the ability to produce a desired or intended result?

Option: Efficacy
Option: Innovative
Option: Semipermeable
Option: Disentangle

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

11. _____ refers to the state of being exposed to the possibility of being harmed or attacked.

12. A _____ is an official who has the power to control or manage certain activities.

13. A corporate _____ is the joining of two or more companies into a single entity.

14. An _____ idea is original creative and introduces a new way of doing things.

15. _____ refers to the process of sending or conveying information from one place to another.

16. _____ in decision-making can lead to lack of clarity and understanding.

17. Being _____ means taking responsibility for one's actions and decisions.

18. To _____ a situation is to separate it from a complex or problematic state.

19. To _____ is to combine or unite to form a single entity.

20. A _____ membrane allows only certain molecules to pass through.

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

21. Parents often their children with important tasks to teach responsibility.
22. The company announced the of all production activities at its plant.
23. Public officials must be held to a high standard of for their decisions.
24. The government agency enforces guidelines for the pharmaceutical industry.
25. The artist perfected a new for blending colors in her paintings.
26. The sudden increase in sales was a surprising and unexpected for the company.
27. The wind caused the of leaves all over the yard.
28. The company was accused of the of natural resources without regard for the environment.
29. The new software introduced an approach to solving common problems.
30. After the flood there was a significant amount of water damage in the basement.

Answer

Multiple Choice: 1. Precarious 2. Misuse 3. Residual 4. Competition 5. Grooming 6. Concerns 7. Infrastructure 8. Assurances 9. Apprehensions 10. Efficacy
Gap-Fill: 11. Vulnerability 12. Regulator 13. Merger 14. Innovative 15. Transmission 16. Opaqueness 17. Accountable 18. Disentangle 19. Amalgamate 20. Semipermeable
Matching sentence: 1. Entrust 2. Cessation 3. Accountability 4. Regulatory 5. Technique 6. Phenomenon 7. Scattering 8. Exploitation 9. Innovative 10. Residual

CATEGORY

1. Sci/Tech - LEVEL5

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