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Borophene-Based Green Lubricant Research

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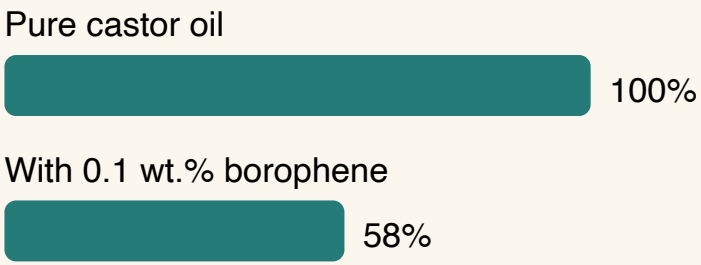
How can a pinch of an exotic material make cooking-grade oil slipperier? Indian scientists added a tiny amount of borophene to castor oil. Friction fell by about 42%. No one had tried borophene as a lubricant additive before.

1 What did the scientists show?

A team at IASST Guwahati used borophene as an additive in castor oil. The Press Information Bureau reported it on 22 July 2026.

What are the key facts?

- The additive amount was just 0.1 wt.% (weight percent).
- Friction fell by about 42% compared with pure castor oil.
- This is the first demonstration of borophene as a lubricant additive.
- IASST is an autonomous institute of the Department of Science and Technology (DST).



About 42% less friction. Original explanatory diagram.

What is the memory hook?

Think “0.1 in, 42 off”. A tiny dose, a big drop.

> **Quick check 1.** The IASST result was reported by PIB on 22 July 2026. *(True or False?)* See answer ↓

Sources: pib.gov.in

2 What is borophene?

Borophene is a two-dimensional (2D) nanomaterial made of boron atoms. A 2D sheet is one atom thick.

What do we know about it?

- Scientists first made borophene on silver surfaces in 2015.
- They worked in ultrahigh vacuum.
- Theory had predicted such boron sheets earlier.
- Unlike bulk boron, borophene shows metallic character.
- Before this study it was studied for batteries, supercapacitors and fuel cells.

What is the memory hook?

Think “boron, not carbon”. Graphene is carbon. Borophene is boron.

> **Quick check 2.** Adding 0.1 wt.% borophene cut friction in castor oil by about 42%. *(True or False?)* See answer ↓

Sources: pmc.ncbi.nlm.nih.gov; sciencedaily.com; pib.gov.in

3 Why was castor oil used?

Castor oil is a renewable and biodegradable lubricant. Its performance alone is limited.

What does the additive fix?

- Friction and wear waste energy and damage equipment.
- A good additive can improve castor oil's performance.
- The aim is an environmentally friendly lubricant.
- Such lubricants could cut wear and tear and lower energy use.

What is the memory hook?

Think "green base, smart additive". Castor oil is the green part.

> **Quick check 3.** Borophene is a two-dimensional material made of carbon atoms. *(True or False?)* See answer ↓

Sources: pib.gov.in

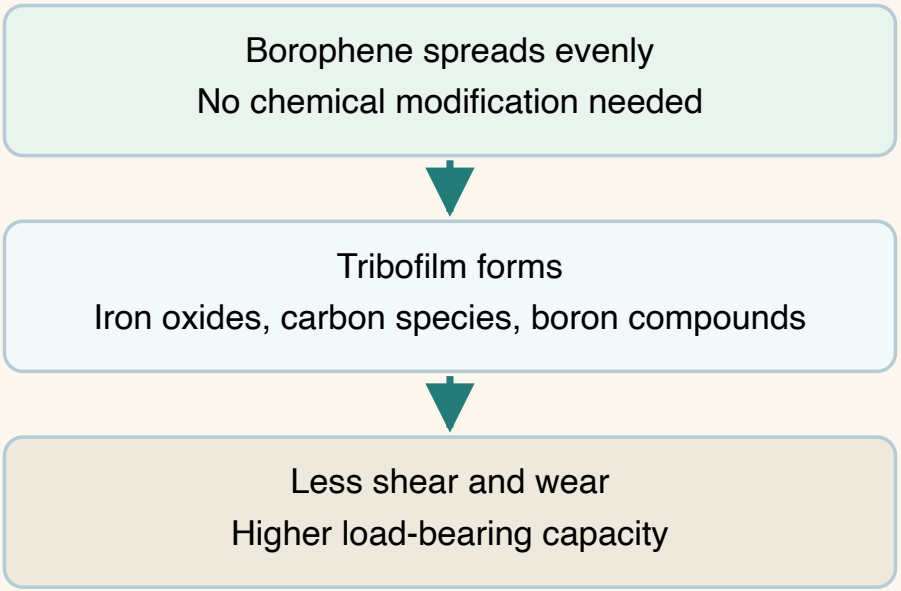
4 How does such a tiny dose work?

The researchers found that borophene spreads evenly in castor oil. No chemical modification is needed.

What forms during use?

- A durable protective layer called a tribofilm forms.
- It contains iron oxides, carbonaceous species and boron-based compounds.
- It reduces shear stress.
- It raises load-bearing capacity.

- It reduces wear.



Spread, film, protect. Original explanatory diagram.

What is the memory hook?

Think “disperse, film, protect”. Three steps.

> **Quick check 4.** Scientists first made borophene in 2015 on silver surfaces. *(True or False?)* See answer ↓

Sources: pib.gov.in

5 Who did the work, and where was it published?

The work was done at IASST in Guwahati, Assam.

Who and what?

- Prof. Devasish Chowdhury guided the research.
- Ujjibit Boruah, an INSPIRE Senior Research Fellow, is the first author.
- The paper appeared in ACS Applied Engineering Materials.
- PIB gave the DOI as 10.1021/acsaenm.6c00540.

What is the memory hook?

Think “Chowdhury guides, Boruah leads the paper”.

> **Quick check 5.** Castor oil is a renewable and biodegradable lubricant. *(True or False?)* See answer ↓

Sources: pib.gov.in

6 Where could this be used?

PIB names four areas where the research could help.

What are the applications?

- Renewable energy systems.
- Marine applications.
- Green lubrication technologies.
- Sustainable manufacturing.

What is the memory hook?

Think “energy, marine, green, manufacturing”.

> **Quick check 6.** Borophene needed chemical modification to mix into castor oil. *(True or False?)* See answer ↓

Sources: pib.gov.in

7 What are the exam traps?

Four mix-ups come up often.

What are the traps?

- **Borophene or graphene?** Borophene is boron. Graphene is carbon.
- **New material or new use?** Borophene dates from 2015. The new part is its use as a lubricant additive.
- **Which oil?** Castor oil, not a mineral oil.
- **Exact numbers.** 0.1 wt.% and about 42%.

What is the memory hook?

Think “boron, new use, castor, 0.1 and 42”.

> **Quick check 7.** The first author of the paper is Prof. Devasish Chowdhury. *(True or False?)* See answer ↓

Sources: pib.gov.in; pmc.ncbi.nlm.nih.gov

Practice MCQs

1. IASST Guwahati scientists showed borophene, added to castor oil, could do what for the first time anywhere?

A. Act as a lubricant additive

B. Replace petroleum entirely

C. Power a battery cell

D. Purify drinking water

See answer ↓

2. How much borophene was added to castor oil in the IASST study?

A. 0.1 wt.%

B. 1 wt.%

C. 10 wt.%

D. 0.01 wt.%

See answer ↓

3. Borophene is a two-dimensional material made of which element?

A. Boron

B. Phosphorus

C. Carbon

D. Silicon

See answer ↓

4. What protective layer forms when borophene works in castor oil?

A. A polymer coating

B. A graphene film

C. An oxide ceramic

D. A tribofilm

See answer ↓

5. Under which Union ministry's department does IASST Guwahati work as an autonomous institute?

A. Department of Science and Technology

B. Department of Biotechnology

C. Department of Space

D. Department of Atomic Energy

See answer ↓

Answer Key

1. **A.** The answer is to act as a lubricant additive. PIB reported the first demonstration of borophene as a lubricant additive on 22 July 2026. Adding just 0.1 wt.% cut friction by about 42% in castor oil. Memory hook: 0.1 in, 42 off. ↑ Q1
2. **A.** The answer is 0.1 wt.%. That tiny amount cut friction by about 42% against pure castor oil. Memory hook: 0.1 in, 42 off. ↑ Q2
3. **A.** The answer is boron. Graphene is the carbon sheet. Borophene was first made on silver surfaces in 2015. Memory hook: boron, not carbon. ↑ Q3
4. **D.** The answer is a tribofilm. It contains iron oxides, carbonaceous species and boron-based compounds. It reduces shear stress and wear. Memory hook: disperse, film, protect. ↑ Q4
5. **A.** The answer is the Department of Science and Technology (DST). IASST is an autonomous institute of DST. It is located in Guwahati, Assam. Memory hook: IASST sits under DST. ↑ Q5

Quick-check answers

1. **True.** The release came from the Ministry of Science and Technology. ↑ 1
2. **True.** The comparison was with pure castor oil. ↑ 2
3. **False.** it is false. Borophene is made of boron. Graphene is carbon. ↑ 3
4. **True.** They worked in ultrahigh vacuum. ↑ 4
5. **True.** Its performance alone is limited, so additives help. ↑ 5
6. **False.** it is false. It dispersed uniformly without chemical modification. ↑ 6
7. **False.** it is false. Ujjibit Boruah is the first author. Chowdhury guided the research. ↑ 7

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