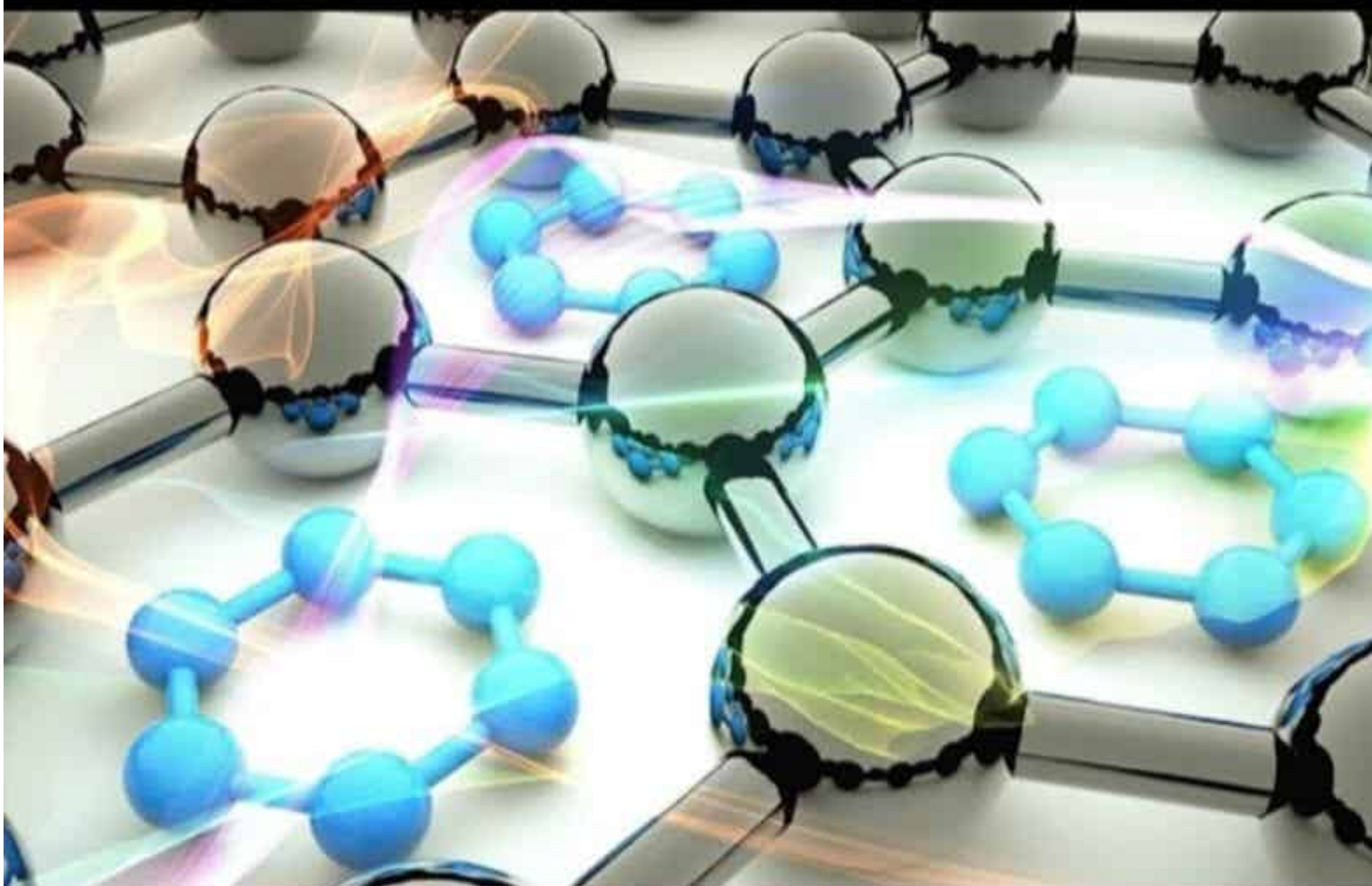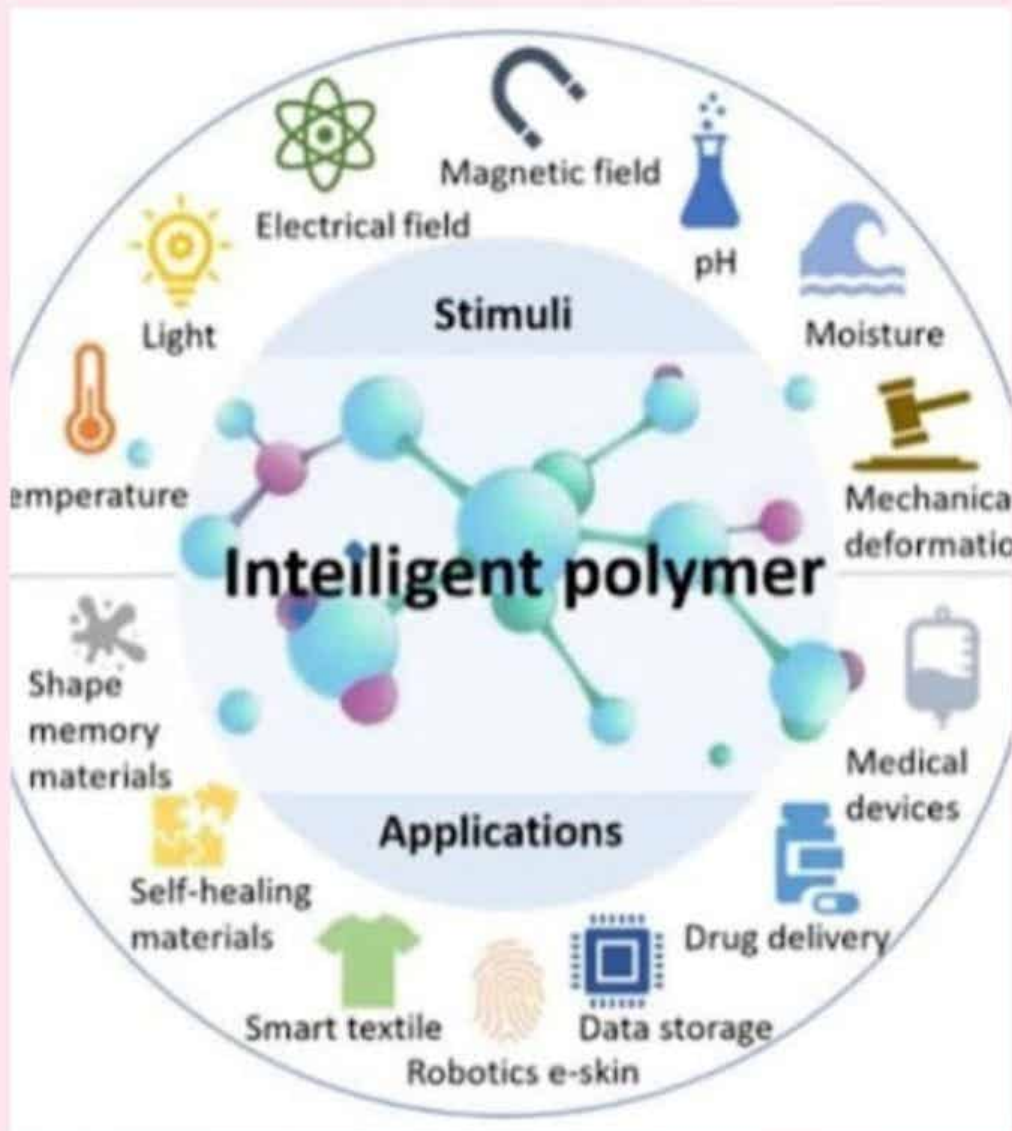# SMART POLYMERS: THE SHAPE-SHIFTING HEROES OF MODERN MATERIALS

Smart polymers are a class of materials that exhibit unique and reversible changes in their properties in response to external stimuli , making them valuable in various applications such as drug delivery, sensors, actuators, and other innovative technologies.

October 19, 2023

SMART POLYMERS

—

Smart polymers: Where science and adaptability merge for a flexible future Smart polymers, also known as stimuli-responsive or intelligent polymers, are a class of materials that exhibit unique and reversible changes in their properties in response to external stimuli. Th ...

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October 19, 2023

SMART POLYMERS

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Smart polymers: Where science and adaptability merge for a flexible future

Smart polymers, also known as stimuli-responsive or intelligent polymers, are a class of materials that exhibit unique and reversible changes in their properties in response to external stimuli. These polymers have gained significant attention in various fields, including biomedicine,

nanotechnology, and materials science, due to their versatile applications. Let's delve into an elaborate explanation of types of smart polymers, and their applications:
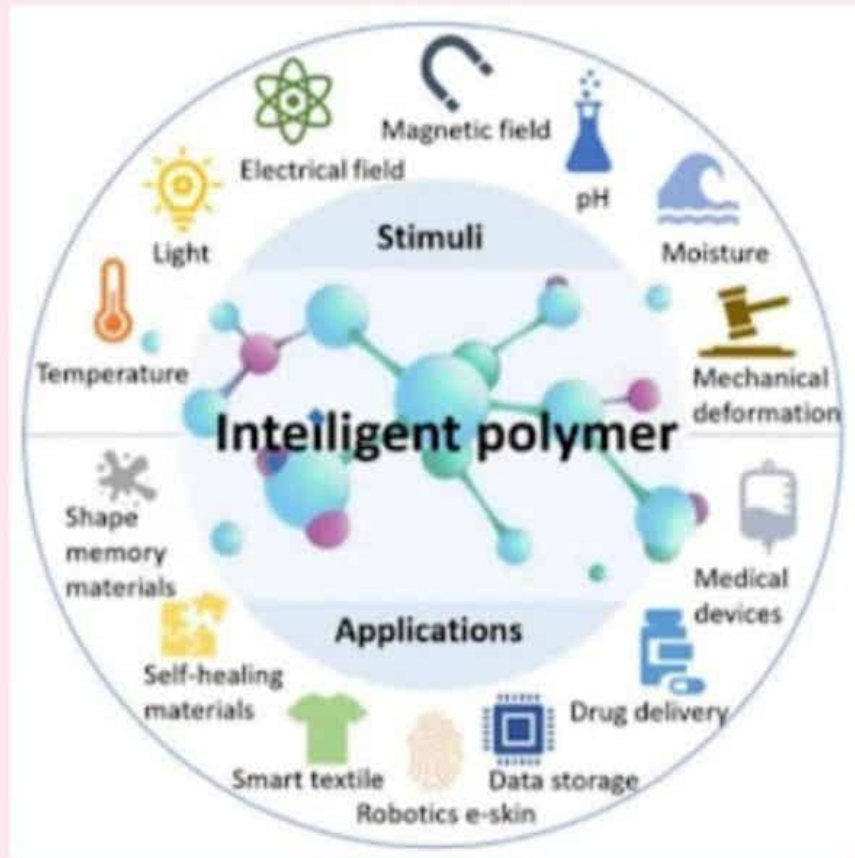
Types of Smart Polymers:

1.Temperature-Responsive Polymers (Thermoresponsive): These polymers undergo a reversible phase transition in response to changes in temperature. A common example is poly(N-isopropylacrylamide) (PNIPAAm), which is hydrophilic below its lower critical solution temperature (LCST) and hydrophobic above it. Thermoresponsive polymers find use in drug delivery, tissue engineering, and chromatography.

2. **pH-Responsive Polymers:** pH-sensitive or pH-responsive polymers change their properties, such as swelling or shrinking, in response to changes in pH. Examples include poly(acrylic acid) and chitosan. These polymers are utilized in drug delivery systems, controlled release, and wound dressings.

3. **Ionic-Strength-Responsive Polymers:** These polymers respond to changes in the ionic strength of their environment. Polyelectrolytes, like poly(4-vinylpyridine) or poly(styrene sulfonate), are examples of ionic-strength-responsive polymers. They are used in applications involving ion exchange, water purification, and responsive coatings.

4. **Light-Responsive Polymers (Photoresponsive):** Photoresponsive polymers change their properties when exposed to specific wavelengths of light. For instance, azobenzene-based polymers undergo reversible photoisomerization upon exposure to UV or visible light. Light-responsive polymers have applications in optics, photopharmacology, and nanotechnology.

5.Electrically Responsive Polymers: These polymers change their properties when subjected to an electric field. Polymers containing conductive materials like polyaniline or polypyrrole are commonly used. Electrically responsive polymers are found in sensors, actuators, and wearable electronics.

6.Magnetic-Responsive Polymers: Magnetic field-responsive polymers are influenced by magnetic fields due to the presence of magnetic nanoparticles. These polymers find applications in drug delivery and tissue engineering, where external magnetic fields can control the location and movement of polymer constructs.


Self Healing Polymer
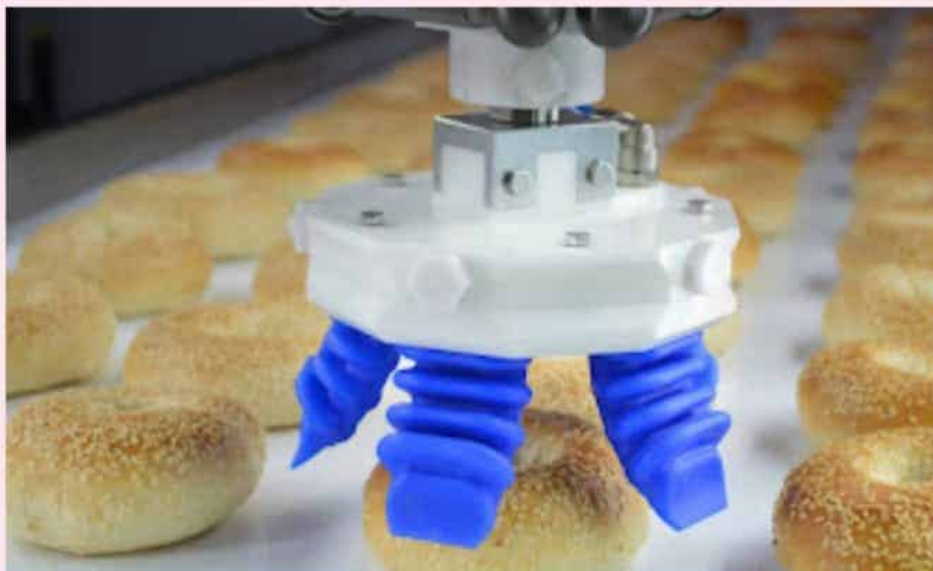
Applications of Smart Polymers:

- **Drug Delivery Systems:** Smart polymers can release drugs in a controlled and targeted manner. For example, a pH-responsive polymer can release drugs in the acidic environment of a tumor. This minimizes side effects and enhances the therapeutic effect.

- **Biomedical Devices:** Smart polymers are used in medical devices, such as shape-memory polymers for stents, which can change shape at body temperature, or contact lenses that change shape in response to moisture content in the eye.

- **Tissue Engineering:** Scaffold materials with thermoresponsive properties can be used in tissue engineering to create three-dimensional structures for cell growth and tissue regeneration.

- **Sensors:** Electrically or chemically responsive polymers are incorporated into sensors for detecting specific analytes. For example, a pH-responsive polymer can be used to create a pH sensor.

- **Responsive Coatings:** Smart polymers are used to create coatings for surfaces that change properties based on external conditions. This can include anti-fouling

change properties based on external conditions. This can include anti-fouling coatings on ships and controlled release coatings on drug tablets.

- *Soft Robotics:* Polymers that change shape or stiffness in response to external stimuli are employed in soft robotics. These materials enable robots to have more flexible and adaptable movements.

- *Waste Water Treatment:* Ion-responsive polymers can be used for the removal of ions and heavy metals from water. They can undergo reversible ion exchange for the purification of water.

- *Optics and Photonics:* Light-responsive polymers have applications in optics and photonics, enabling the development of devices like light modulators and switches.
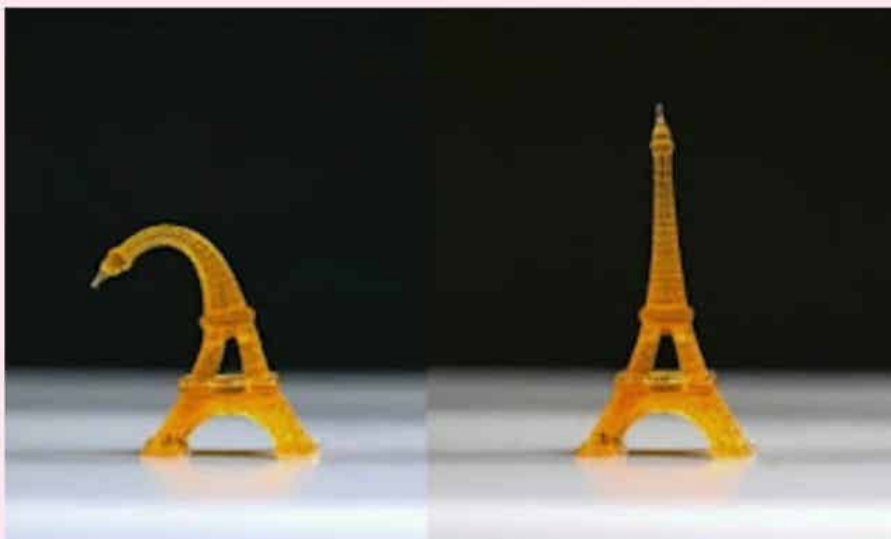
Shape Recovery
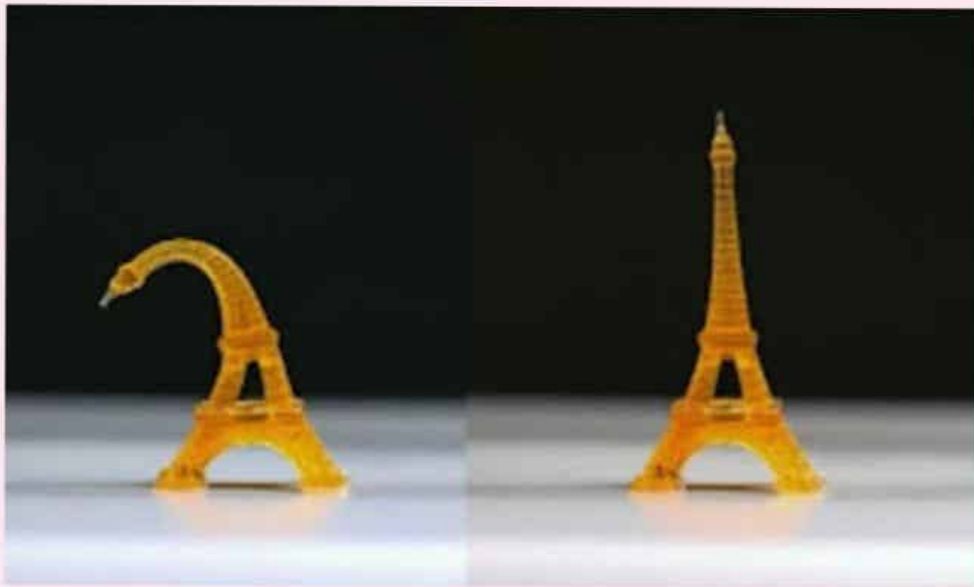
Shape Recovery

Smart polymers are an exciting and evolving field in materials science and engineering. Their ability to respond to various stimuli in a controlled and reversible manner opens up a wide range of applications, offering innovative solutions in fields such as biomedicine, nanotechnology, and materials engineering. As research in this area continues to advance, we can anticipate even more fascinating and practical applications for smart polymers in the future.

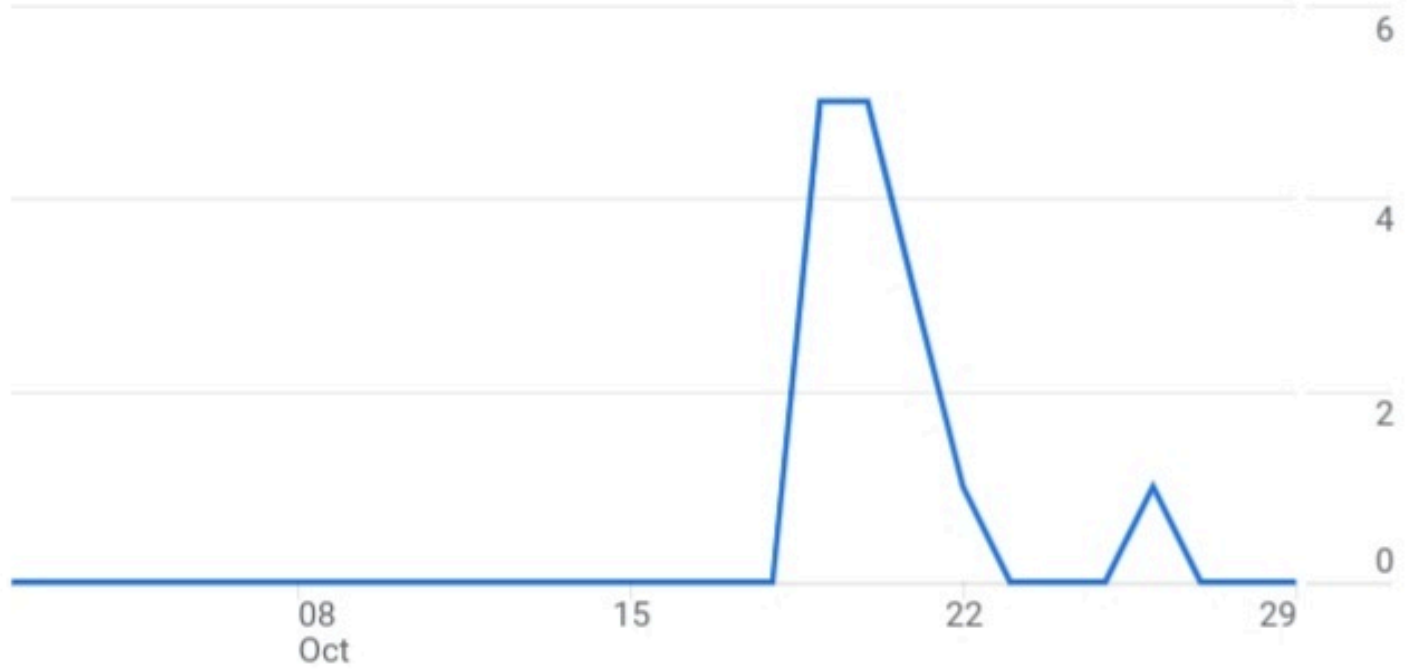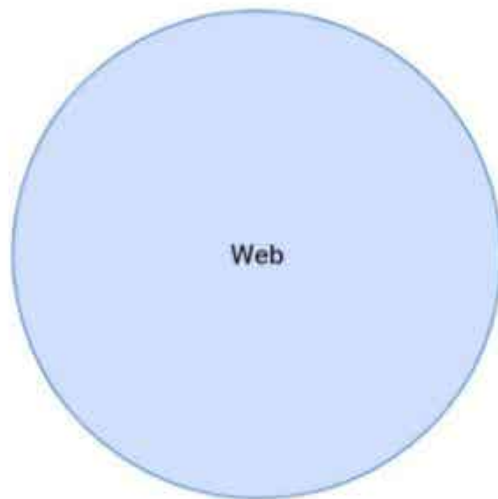"Intelligent polymers:Shaping a smarter, more adaptable tomorrow"

Users by Platform

WEB
100.0%

Web

View platforms →

USERS IN LAST 30 MINUTES
1

USERS PER MINUTE

TOP PLATFORMS	USERS
web	1

View real time →

Users ▾ by Operating system

OPERATING SYSTEM	USERS
Android	7
Windows	4

Users ▾ by Country

COUNTRY	USERS
India	11

View countries →

USERS IN LAST 30 MINUTES

1
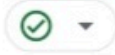
USERS PER MINUTE

TOP COUNTRIES	USERS
India	1

View real time →

Users ▾ by Town/City

TOWN/CITY	USERS
Chennai	9
Coimbatore	1
Hyderabad	1
Nagercoil	1

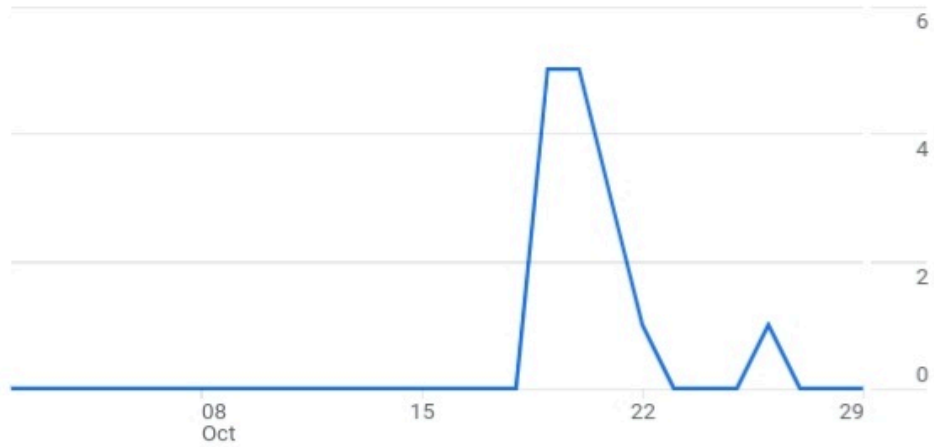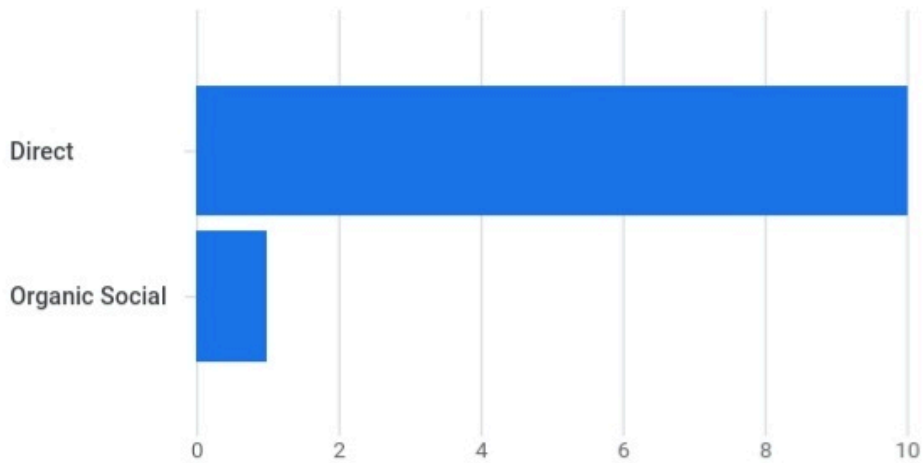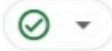| Users	New users
11	11

WHERE DO YOUR NEW USERS COME FROM?

New users by First user default channel group▾

View user acquisition →

Views by Page title and screen class

PAGE TITLE AND SCREEN CLASS	VIEWS
Smart Polymers	33
Smart polymers: The shape-shifting heroes ...	25

Users ▾ by Country

COUNTRY	USERS
India	11

View countries →

Users ▾ by Town/City

TOWN/CITY	USERS
Chennai	9
Coimbatore	1
Hyderabad	1
Nagercoil	1

View cities →

< **Average engagement time** ⑦ | Engaged sessions per >

0m 50s | **1.5**

1m 20s
1m 00s
0m 40s
0m 20s
0m 00s

08   15   22   29

Users by Session default channel group over time

Users by Session c

6

4

2

0

Direct

Organic Social

0

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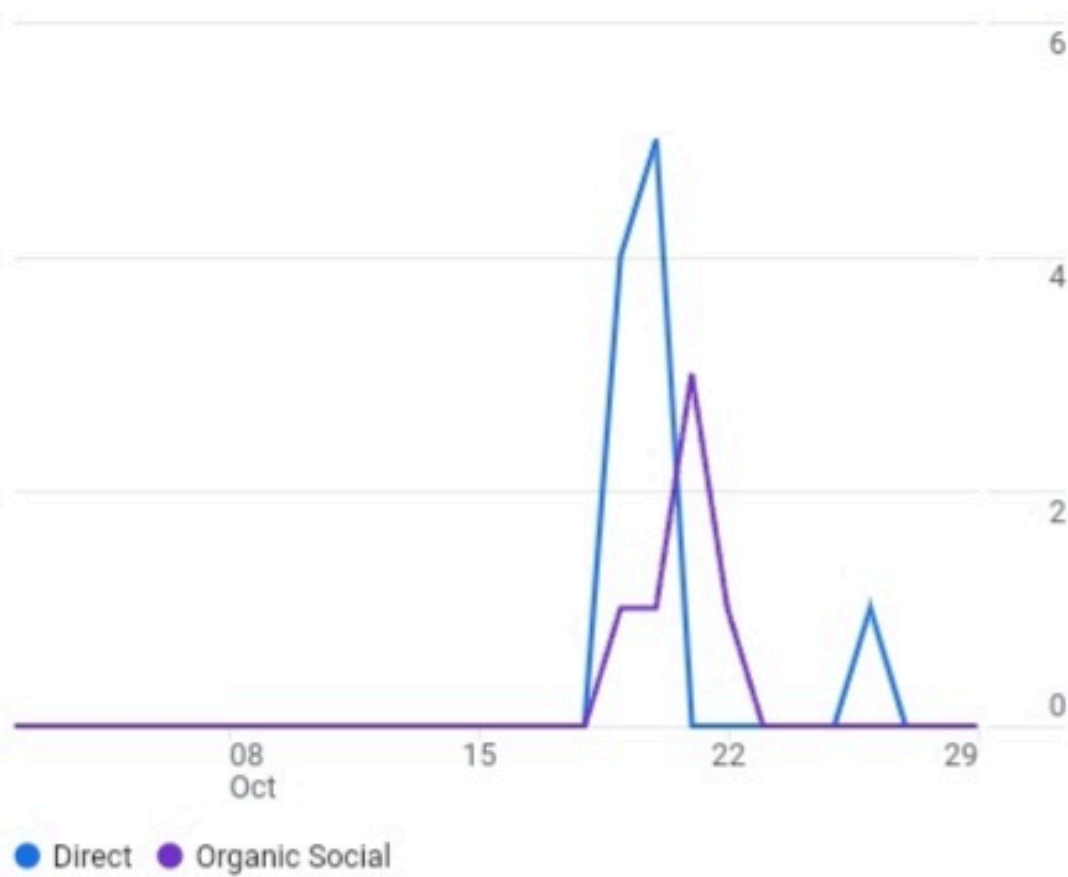
● Direct ● Organic Social

Q Search...

Rows per page

Session default channel group ▾ +	↓ Users	Sessions
	11 100% of total	**17** 100% of total
1 **Direct**	10	10
2 **Organic Social**	4	7

Users by Audience over time
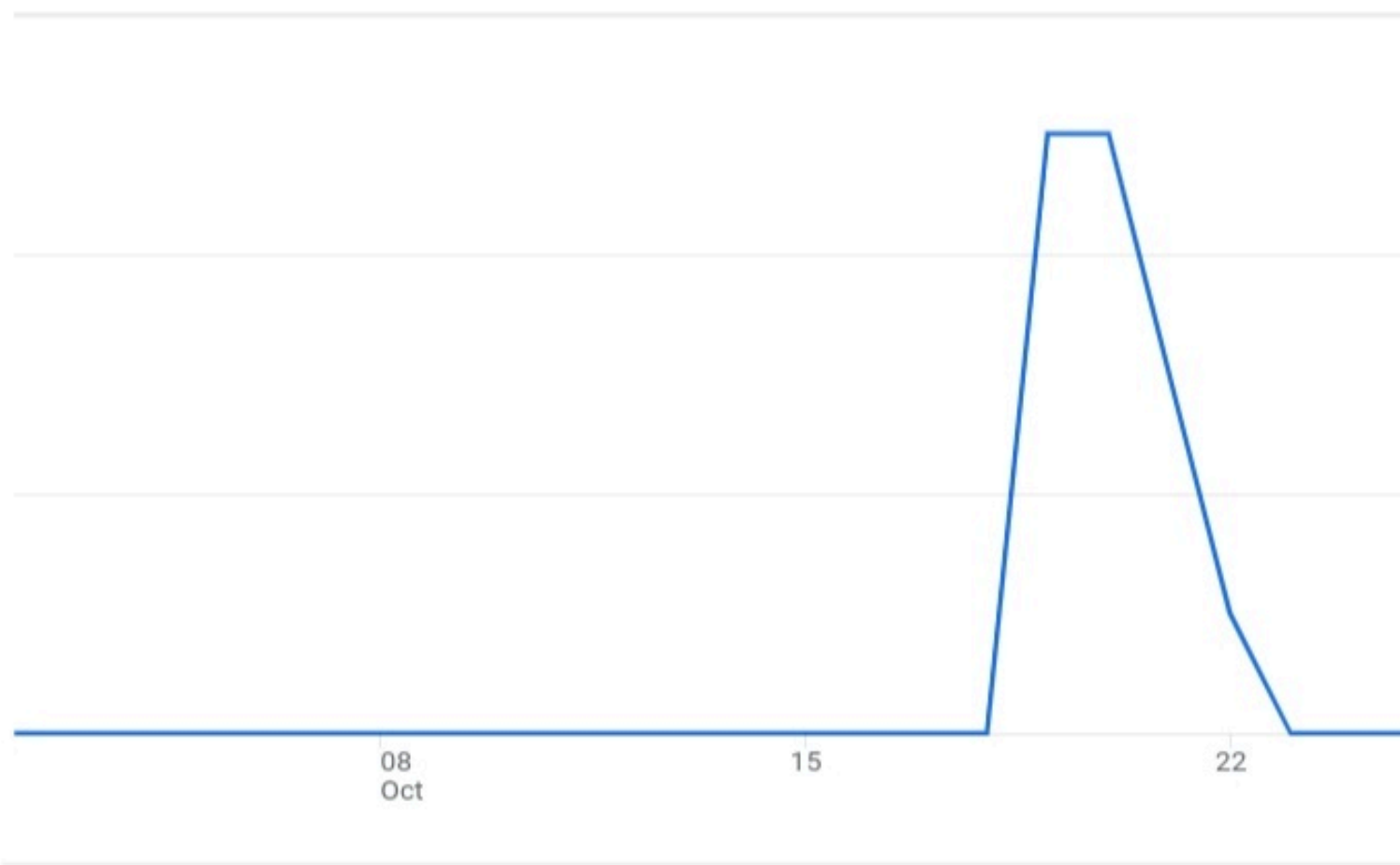
New users ▾ by First user default channel group ▾   ⊘ ▾

FIRST USER DEFAULT CHANNEL GROUP	NEW USERS
Direct	10
Organic Social	1

View user acquisition →

HOW WELL DO YOU RETAIN YOUR USERS?

User activity by cohort   ⊘ ▾
Based on device data only

	Week 0	Week 1	Week 2	Week 3	Week 4	Week 5
All Users	100.0%	10.0%	0.0%	0.0%	0.0%	0.0%
17 Sept - 23 Sept						
24 Sept - 30 Sept						
1 Oct - 7 Oct						
8 Oct - 14 Oct						
15 Oct - 21 Oct						
22 Oct - 28 Oct						

6 weeks ending Oct 28

New users
11

Returning users
4