Where it matters

Tracking the performance of four heavyweights and a rising star in materials science to reveal country strengths. **Data analysis by Catherine Cheung. Infographic by Bec Crew and Tanner Maxwell**

CHINA

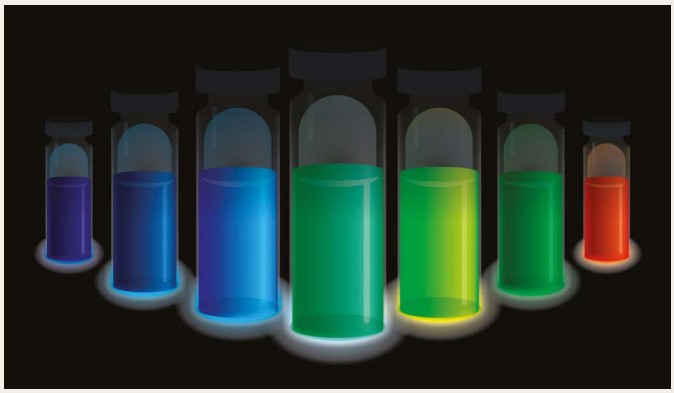
- **Population:** 1.4 billion
- **GDP per capita:** US$10,216.6
- **Rank in materials science 2020:** 1

China dominates materials science output in the Nature Index, having replaced the United States in the top spot in 2018. It's also the fastest-rising country in the field, with a 20.9% increase in Share for 2018–20.

Top country collaboration

China **662.94** — United States **522.54**

Bilateral collaboration score **1,185.47**



Selected paper: This paper, led by China's Nanjing University of Science and Technology, presents a type of inorganic perovskite nanocrystal for use in quantum dot-based light-emitting diodes — a material used in lighting and display devices. It was among the most highly cited materials-science papers in the Index in 2018–20 (J. Song *et al. Adv. Mater.* **27**, 7162–7167; 2015).

UNITED STATES

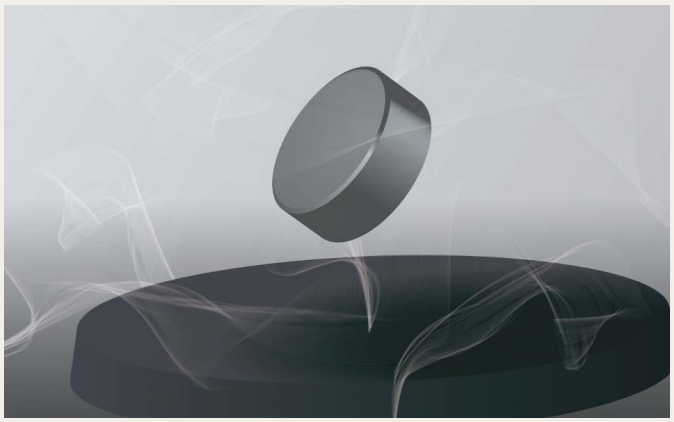
- **Population:** 328.2 million
- **GDP per capita:** US$65,297.5
- **Rank in materials science 2020:** 2

The United States' output in materials-science research increased slightly in the index in 2020, ending a years-long downward slide. Its top institution in the field, the Massachusetts Institute of Technology, is ranked 10th, after institutions from China, Germany and Singapore.

Top country collaboration

United States **522.54** — China **662.94**

Bilateral collaboration score **1,185.47**



Selected paper: Led by the University of Rochester, New York, this study achieves room-temperature superconductivity. Created by pressing a chemical compound in a diamond anvil and exposing it to a laser, the superconductor repels magnetic fields, causing levitation. The paper had the second-highest Altmetric score in materials-science articles in the Index for 2015–20 (E. Snider *et al. Nature* **586**, 373–377; 2020).

GERMANY

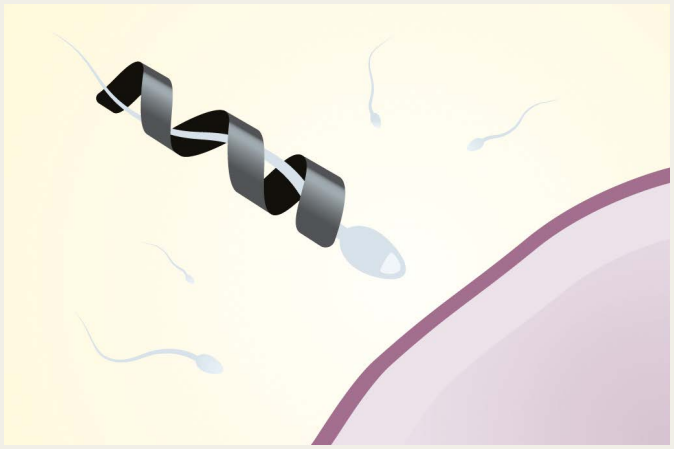
- **Population:** 83.1 million
- **GDP per capita:** US$46,467.5
- **Rank in materials science 2020:** 3

After a sharp decline from 2015, Germany's materials-science Share recovered in the period 2019–20. The Max Planck Society, its best performer in the field, was ranked fourth in 2020, the highest place for a non-Chinese institution that year.

Top country collaboration

Germany **110.51** — China **143.15**

Bilateral collaboration score **253.65**



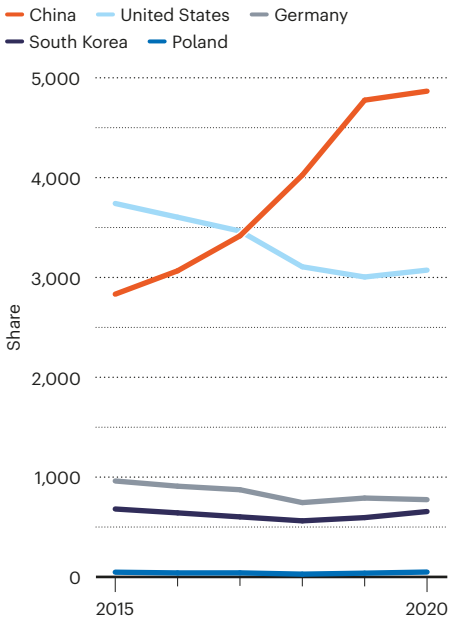
Selected paper: A mechanism to motorize sluggish sperm cells is described in this paper led by the Leibniz Institute for Solid State and Materials Research in Germany. The team built micromotors that attach to the tails of sperm cells and function like an outboard motor. The paper has one of the highest Altmetric scores of materials-science articles in the Index for 2015–20 (M. Medina-Sánchez *et al. Nano Lett.* **16**, 555–561; 2016).

SOURCE: NATURE INDEX, WORLD BANK, NATIONAL BUREAU OF STATISTICS OF CHINA

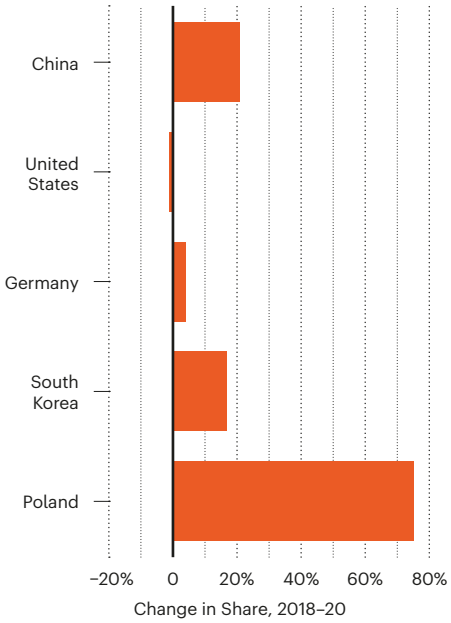
SELECTED GLOBAL CONTENDERS

China has a commanding lead in materials-science-related output in the Nature Index, having overtaken the United States as the most prolific country in 2018. But the US is showing signs of a comeback; it was the second-fastest rising country in the field in 2019–20, up from 99th in 2018–20. Poland has achieved a strong increase from a low base.

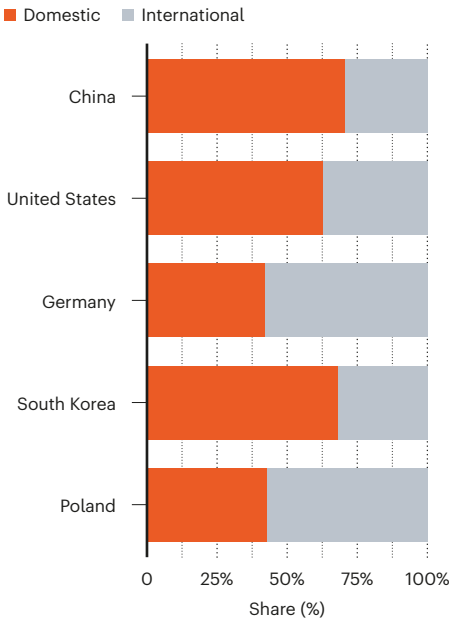
Share, 2015–20



Change in Share, 2018–20



International collaboration



SOUTH KOREA

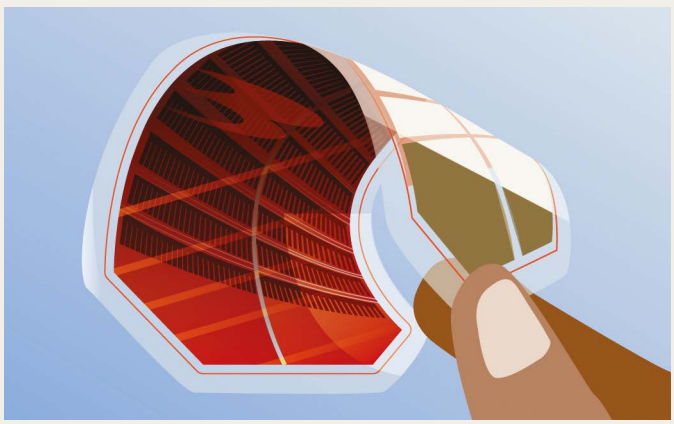
- **Population:** 51.7 million
- **GDP per capita:** US$31,846.2
- **Rank in materials science 2020:** 5

In fifth place in materials-science research output after Japan, South Korea was also the second-fastest rising nation in the field in 2020, with a 16.6% increase from 2018 to a Share of 665.30 in 2020.

Top country collaboration

South Korea **108.95** United States **119.07**

Bilateral collaboration score **228.01**



Selected paper: Scientists from the Korea Research Institute of Chemical Technology describe a new process for creating perovskite-based solar cells that reached efficiencies of up to 20.2%, among the highest efficiency rate reported at the time of the paper's publication. It is the most highly cited materials-science paper in the 82 high-quality journals tracked by the Index in 2015–20 (W. S. Yang *et al. Science* **348**, 1234–1237; 2015).

POLAND

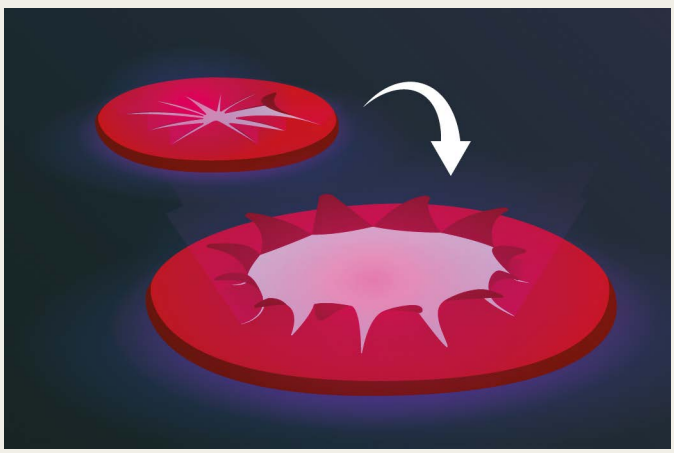
- **Population:** 38 million
- **GDP per capita:** US$15,694.7
- **Rank in materials science 2020:** 23

Poland has achieved a rapid rise in materials-science research output. From 2018 it had a remarkable 75% increase to a Share of 48.98 in 2020, which puts it in ninth place among the fastest-rising countries — a trajectory it will need to maintain to break into the top 20 countries in the field from its current 23rd place.

Top country collaboration

Poland **6.81** Germany **15.71**

Bilateral collaboration score **22.53**



Selected paper: A team from Tampere University in Finland and Wrocław Medical University in Poland used a light-controlled polymer material to create an artificial iris. The study, which describes how the device reacts to incoming light similar to a human eye, is among the highly cited of materials-science articles in the Index for 2015–20 involving one or more Poland-based authors (H. Zeng *et al. Adv. Mater.* **29**, 1701814; 2017).