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# APPLICATIONS OF NANOTECHNOLOGY

**Nanotechnology is the science, engineering, and technology at the nanoscale.** One nanometer is a billionth of a meter or  $10^{-9}$  of a meter. For comparison, a sheet of newspaper is about 100,000 nanometers thick.

Nanoscale technology is used in various devices and materials. The common trait these technologies share is that the physical effects of the atoms at the nanoscale alter the materials' properties. These technologies explore the benefits that nanotechnology offers.

**Here are some of the top applications for nanotechnology, according to the National Nanotechnology Initiative.**

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## 1 AUTOMOTIVE TECHNOLOGY



Nano-engineered materials in the automotive industry include high-power rechargeable battery systems, thermoelectric materials, tires with lower rolling resistance, high-efficiency/low-cost sensors and electronics, and fuel additives for cleaner exhaust and extended range.

## 3 COMPOSITE MATERIALS



Nanoscale additives in polymer composite materials are being used to make cars, airplanes, and spacecraft lighter. For example, carbon nanotube sheets are being used in next-generation air vehicles in the hopes of gaining higher fuel efficiency.

## 5 SMART FABRICS



Nanoscale materials can be found in washable and durable fabrics. They are equipped with flexible nanoscale sensors and electronics with capabilities for health monitoring, solar energy capture, and energy generation through the user's movement.

## 7 SOLAR CELLS



Nanotechnology can be used in solar panels to convert sunlight to electricity more efficiently. Manufacturers can print flexible panels that can be rolled. Researchers are developing thin-film solar electric panels that can be fitted onto computer cases to be used as a portable energy source.

## 9 MEDICAL TISSUE ENGINEERING



Nanotechnology for regenerative medicine, including bone and neural tissue engineering. For instance, nanomaterials can be engineered to mimic the crystal mineral structure of human bone or dental applications. Researchers are currently investigating how conductive graphene nanoribbons can be used to help repair spinal cord injuries.

## 2 CHEMICAL CATALYSTS



Nanoparticles are used increasingly in catalysis to boost chemical reactions, reducing the number of materials necessary to produce desired results, saving money, and reducing pollutants. Two big applications are in petroleum refining and automotive catalytic converters.

## 4 INFRASTRUCTURE SENSING



Nanoscale sensors are being used in bridges, tunnels, rails, and buildings. They provide continuous monitoring of its structural integrity and performance. The sensors can be embedded into the construction materials to offer continuous monitoring.

## 6 WATER FILTRATION



Using chemical reactions, nanoparticles are being developed to clean industrial water pollutants in groundwater. Researchers are also designing magnetic water-repellent nanoparticles that can be used oil spills and be used to remove the oil from the water by using magnets.

## 8 CHEMICAL DETECTION



Nanotechnology sensors can be used to detect and identify chemical or biological agents in the air and soil. Researchers are investigating different particles to detect chemicals in the air. Researchers are determining how to apply the unique chemical and physical properties of each for toxic site remediation.

## 10 FLEXIBLE ELECTRONICS



Bendable and stretchable electronics are being integrated into a variety of products, including wearables, medical applications, and aerospace applications. Nanomaterials like graphene and cellulosic materials are being used in "tattoo" sensors, photovoltaics that can be sewn onto clothing, and electronic paper that can be rolled up.