Sustainable Future Using Materials Science

A sustainable future using materials science is achieved through developing new materials and technologies that can help address climate change and resources.

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NEW YORK, USA, May 29, 2022 /EINPresswire.com/ -- From smartphones to high-speed trains, many modern-day products depend heavily on dwindling resources, the exploitation of which has high environmental and economic expenses. According to Liu, Professor and McDevitt Chair of Physics at Georgetown University, we need a bigger toolbox to create greener technology that helps with a sustainable future.

He says, “It’s fascinating as it’s a completely new world. Also, we have the power to form up new materials at the atomic level which possess novel properties besides those defined in their bulk forms.”

Boron: An Element for a Sustainable Future
Permanent magnets are used in various applications, including hybrid /electric vehicles, magnetically levitated trains, power storage, wind turbines, and consumer electronics. However, the rare earth elements they depend on are hard to mine and can be expensive. As a result, there is a critical need to develop replacements that use fewer or even no rare earth elements.

Researchers hope that boron-based magnets will lower the carbon footprint in producing permanent magnets that will have similar properties to those made with rare-earth elements. This advancement will make cutting-edge technology accessible, and an eco-friendly choice for many industrial applications.

Neodymium magnets are one of the strongest types of permanent magnets. They’re made from neodymium, iron, and boron, and they have a very high resistance to heat and corrosion. These magnets are known for their ferromagnetic properties, which means they can be magnetized easily and hold onto their magnetism well. They are considered the most powerful magnets due to their smallest size rare earth magnetic materials with a higher density per volume.

Neodymium magnets make advancements in medicine and renewable energy production for a sustainable future. These magnets are super-strong magnets that need low-heat, high power sources and are resistant to magnetic demagnetization; hence can be made in various shapes and sizes. They are versatile materials that can be used for almost anything.

Investigating New Magnetic Recording Media

One area where researchers see the potential for significant improvement is how we store data in computers. The areal density of magnetic recording media has dramatically increased in recent years, thanks to advances in nanoscale magnets.

The property that allows digital data to be stored in ever-shrinking magnets is the tendency of each bit to sustain its magnetic moment, known as magnetic anisotropy. Present magnetic recording media have precious metals, which are inexpensive and unsustainable.

Liu and Gen Yin recently received a grant from National Science Foundation to research magnetic recording media via high entropy routes to create novel magnetic alloys.

These alloys include various elements, and, surprisingly, they can form stable structures with improved properties. This approach will create novel phases for magnetic recording media applications that cannot be obtained through conventional means.

Producing Skyrmions from Thin Air

Liu is hopeful that his research on magnetic skyrmions will lead to a new way of storing digital information. Tiny magnetic knots can be formed by incorporating topology into how nanoscale magnets are oriented. These nanomagnets are excellent information carriers.

Magnetic skyrmions are a type of quasi-particle having a whirling configuration. These nano-sized imbalances are made from a series of knotted, interlocking magnetic moments invisible to the naked eye. A skyrmion’s interlocking nature provides topological protection and stability.

By implementing a single layer of a hydrogen atom in an inert atmosphere onto the surface of a thin magnetic film, researchers introduced a new technique of writing and deleting skyrmions, which correspond to the “1” and “0” states, respectively, at room temperature. This is very useful as it’s a non-contact way to write and remove information with no need for multiple electrical leads.

Tie-ups between Research Institutions and Industry

Mining extraction companies are getting involved in research projects as part of their commitment to understanding and communicating how minerals like boron can be used in new applications, not only for commercial advantage but for sustainability and decarbonization, advanced energy, and food security.

One such company is 5E Advanced Materials, whose California activities involve boron extraction and the boron advanced materials production, recently sponsored Liu's research group. 5E Advanced Materials, previously known as American Pacific Borates, aims to be a vertically integrated leader in the boron advanced materials business. Boron products are in high demand for critical, high-value applications such as electric transportation, clean energy, food security, and permanent magnets.

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