Magnetic Nanoparticles:
Atom-sized structures that leave imprints spanning Earth

By Christopher Gohlke

The next big breakthrough

Pretend for a moment that you’re back in the 19th century. The latest technology, the hottest new product everyone’s talking about, is Thomas Edison’s light bulb. The stethoscope makes its first appearance in the medical field, though aspirin and cocaine are about the only two drugs doctors can prescribe at this point.

Jump forward a hundred years to the 20th century. You’ve traded your knickers for a pair of jeans, and life’s a little more enjoyable with luxuries such as television and cars. Computers creep into the limelight, and although they start out the size of living rooms and process information at the speed of a snail, they eventually transform the way the world functions. Medicine takes a leap forward, too, when the creation of antibiotics and the development of organ transplantations begin to extend the average life expectancy and provide a reliable safety net for everything from the common cold to heart failure.

Fashion obviously wasn’t the only trend that’s changed over time. Transformations in society have historically been spawned by advancements in critical areas such as technology and medicine. From the Victorian era of the 1800s to the “flower power” age of the twentieth century, our culture has progressed along with our knowledge of science and our understanding of the way the world works.

When our great-great-grandchildren look back on our generation, then, what will they cite as the greatest innovations of our day? What discoveries will define us?

The answer lies beneath the lens of the world’s most powerful microscopes.

It’s so small you wouldn’t even know you’re holding it in your hand, but it’s about to revolutionize everything from technology to medicine and – just maybe – even the fashion world. Meet the magnetic nanoparticle, the widget at the epicenter of science’s next big breakthrough.
Everything’s about to change, and magnetic nanoparticles have paved the way for a new wave of science.

Well, what are these tiny things?

For starters, we must go back to the basics and define nanotechnology, which is the overarching science dedicated to studying nanoparticles. “Nano,” literally, means one-billionth of something – a nanogram, a nanometer – you get the picture. Basically, nanoscience is the study of really, really small things. These things are called nanoparticles.

A nanoparticle is anything that is measured on such a tiny scale. These could be atoms or molecules or even tiny mechanisms developed by the scientists who are on the cutting edge of creating new nanotechnologies.

Magnetic nanoparticles are those tiny structures that have a magnetic “charge” (scientists call it a magnetic “moment”) and are composed of magnetic atoms. Studying magnetic nanoparticles and their properties is alluring to scientists because these particles can give them clues about basic structures in various branches of science, from biology to chemistry to engineering.

Why are they important?

A cure for cancer. A supercomputer that could fit in the palm of your hand. A drug that can be “steered” to a destination cell. According to some scientists, all these things could be possible with the use of magnetic nanoparticles.

How could something so small that it’s invisible to the naked eye revolutionize not just science, but the way each and every person lives his or her life – or death? Just ask Saw-Wai Hla, a professor of nanoscience at Ohio University.

“Some scientists are trying to use magnetic nanoparticles to treat cancer or to follow the movement of biological molecules, like protein,” he said. “Due to their magnetic properties, these particles can be traced during their movement.”

Scientists can use magnetic nanoparticles, for instance, to track the progress of a new drug through a person’s body, or they can even use magnets outside the body to “guide” the drug to specific cells. The use of this new technology could change the way many diseases are treated, with some touting magnetic nanoparticles as the key to finding a cure for cancer.
Magnetic nanoparticles aren’t only helpful in medicine. “One potential application is in computer memory devices,” Hla said. Computers might soon be getting a makeover as companies such as IBM look into using magnetic nanoparticles to recreate and redevelop hard drives and computer memory.

Smaller components in computers means that more information and memory can fit in the same amount of space, a clue that computers might soon become considerably faster and capable of holding infinitely more information.

**What’s the future look like?**

Imagine the changes that occurred when computers were developed, and how the medical field adapted to continual advancements in medicine. Now imagine what will happen if everything we know about these things is turned on its head by a single particle that is one-billionth of a meter in length.

Tadeusz Malinski, a renowned professor of biochemistry at Ohio University, thinks that’s about to happen. Malinski has done extensive research on the topic, including a recent study that analyzed the toxicity of nanoparticles in the human body.

“In this day, we operate on a very macroscopic level,” he said. He noted that most scientists now will examine what they can see – a person with a disease, for example – and try to figure out the underlying causes for it. Using nanotechnology, they can instead examine the “invisible” underlying causes to explain why that person, for instance, has cancer or Alzheimer’s disease.

“By using nanoparticles, we can build a picture from the base up,” he explained. “In other words, we are reversing our approach.”

It’s hard to say where magnetic nanoparticles will take us in the future. Because their importance stretches across the sciences and into the everyday lives of almost everyone on the planet, the significance of this new technology cannot be exacted on any measurable scale.

Wherever nanotechnology takes us, one thing is clear: As society continues to transform over time, perhaps we’ve finally realized that the solution to some of our age-old problems might have been under our noses the entire time. It was just too small to see.