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Chad Mirkin: Standing Tall in a Nanoparticle Universe

Chad Mirkin's nanotechnology could muster impossibly small bits of stuff to fight numerous ailments

By Sarah Baldauf
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Chad Mirkin has, by all accounts, developed a masterly ability to think small—extraordinarily small. Nanoscience, the 6-foot, 4-inch Northwestern University chemist's domain, is all about teensy particles on the scale of atoms and molecules. Yet his work has gargantuan implications. Someday neurosurgeons, after cutting out as much of a tumor as possible, may bathe patients' brains with mutation-seeking nanoparticles—crafted in Mirkin's lab—that home in on any remaining cancer cells. Other Mirkin innovations could help diagnose and treat Alzheimer's and will soon be wielded against heart disease and prostate cancer.

Chad Mirkin, Nanoscientist and Chemist, Northwestern University

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What makes Mirkin a "dynamo" is his acumen in recognizing how scientific insights can be applied to unmet real-world needs—particularly in medicine, says Joseph DeSimone, an esteemed chemistry professor at the University of North Carolina and 2008 winner of the Lemelson-MIT Prize, which honors inventors. In the mid-1990s, when nanoscience was in its infancy, scientists in Mirkin's lab created a kind of nanoparticle that, they found, changed from red to blue when it encountered mutated DNA. Nifty chemistry, indeed, but Mirkin instantly realized that the team had discovered much more than a minuscule science trick. By using the color-changing particles, he reasoned, he could design tests to highlight genetic markers for many diseases, including cancers.

That eureka moment in the lab, Mirkin recalls, produced "a lot of high-fives"—and a flurry of follow-up research. Nanoparticles could also be used for treatment. They can enter cancer cells and regulate genes, telling the cells to die instead of proliferate. A vast improvement over the current practice of blasting the whole body with toxic treatments, he says.

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Mirkin's lab has since developed other nanoparticles that can signal the presence of proteins associated with certain diseases, like one released when a person is having a heart attack. In the emergency room, where a misdiagnosis "could mean the difference between life and death," the protein test could differentiate "those that are having a heart attack and those that just have indigestion," he says. A company Mirkin started is bringing to market nano-based diagnostic tools for the heart attack protein and a prostate cancer marker, and it may also do so for what is hoped to be a marker of early-stage Alzheimer's.

What is "game changing" about the work, says Mirkin, is that nanotechnology picks up disease markers that fly way below the radar of traditional diagnostics. For example, Mirkin helped develop a nano-based test that can spot prostate cancer recurrence "years earlier," he says, than the so-called PSA test, the current standard used after prostate surgery. The test could also measure the impact of experimental drugs.

Such high-impact work has earned Mirkin, 45, a dizzying number of honors at a relatively young age. In April, he was named to President Obama's Science and Technology Advisory Council, and in June he won the coveted Lemelson-MIT award. Part of what has garnered Mirkin such success, says Mark Ratner, the Northwestern professor of chemistry who hired him, is that he focuses on the scientific riddles that most need to be answered before charging down a path. "If you choose the wrong problem, you're in trouble to begin with," says Ratner. "Chad doesn't go off on a dead end very often."

Mirkin's upbringing and competitive streak may have forged that focus. With three older brothers who are all successful in the sciences—a geologist, a physicist, and an orthopedic surgeon—Mirkin chose to hone his aptitude for chemistry. That particular science, he says, "was the one my brothers hadn't done."

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