Nanotech pioneer, buckyball discoverer, Nobel laureate Richard Smalley dead at 62

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Nobel laureate Richard Smalley, co-discoverer of the buckyball and one of the best-known and respected scientists in nanotechnology, died today in Houston after a long battle with cancer. He was 62.

Smalley, who joined Rice University in 1976, shared the 1996 Nobel Prize in Chemistry with fellow Rice chemist Robert Curl and British chemist Sir Harold Kroto for the discovery of buckminsterfullerene, or "buckyballs," a new form of carbon.

Smalley died this afternoon at M.D. Anderson Cancer Center, surrounded by family and friends. He is survived by his wife, Deborah Smalley; two sons, Chad and Preston; a brother, Clayton; two sisters, Linda and Mary Jill; stepdaughters Eva and Allison; granddaughter Bridget and a host of friends and relatives.

"We will miss Rick's brilliance, commitment, energy, enthusiasm and humanity," Rice President David Leebron said. "He epitomized what we value at Rice: pathbreaking research, commitment to teaching, and contribution to the betterment of our world. In important ways, Rick helped build and shape the Rice University of today. His extraordinary scientific contributions, recognized with the Nobel Prize, will form the foundation of new technologies that will improve life for millions. His life's work and his brave fight against a terrible disease were an inspiration to all."

Colleagues and scientific leaders say it is hard to overestimate the role

Smalley played in founding and fostering the development of nanotechnology, one of the most important and exciting new areas of scientific inquiry to arise in the past quarter century.

"Rick was incredibly creative and had the ability to make his creative vision a reality," said Curl, University Professor Emeritus, the Kenneth S. Pitzer-Schlumberger Professor Emeritus of Natural Sciences and professor emeritus of chemistry. "His mind was sharp and incisive. Whenever I brought up some point that I thought he might have overlooked, I found that he had already thought of it and refuted it in his own mind. I have met many eminent scientists; I've never met anyone smarter, more creative, and more focused. His mind was like a searchlight bringing whatever it looked at into clarity."

No one was better than Smalley himself at describing the discipline in plainspoken terms.

"We are about to be able to build things that work on the smallest possible length scales, atom by atom, with the ultimate level of finesse," Smalley told the U.S. House of Representatives while testifying in 1999 in support of the National Nanotechnology Initiative (NNI). "These little nanothings, and the technology that assembles and manipulates them -- nanotechnology -- will revolutionize our industries and our lives."

Nanotechnology draws its name from the nanometer, or one-billionth of a meter. Buckyballs measure one nanometer in diameter, and their discovery at Rice in 1985 is frequently cited as one of the earliest and most influential discoveries in the development of nanotechnology.

"In my view, this was a singular event in the history of nanotechnology," said Neal Lane, senior fellow in science and technology at Rice University's Baker Institute for Public Policy. "It not only created a whole new field of 'fullerene chemistry,' it immediately made feasible the notion of making things from the bottom up, just as physicist Richard Feynman had predicted 50 years earlier."

Fullerenes -- the family of compounds that includes buckyballs and carbon nanotubes -- remained the central focus of Smalley's research until his death, and Smalley himself never shied away from espousing the importance of fullerenes, particularly carbon nanotubes.

"(Fullerene research) probably has transcendent importance in many areas of technology and perhaps in society," Smalley told Small Times magazine in 2001. "It's a heady thing to be involved. It's almost like church."

Due in part to Smalley's leadership, the U.S. launched the NNI in 2000. NNI is a sweeping federal research-and-development program that coordinates the nanotech efforts of nearly two dozen federal agencies, including the National Science Foundation, the Department of Defense and NASA. NNI funding has more than doubled in the past five years, with federal spending for 2005 topping $1 billion.

At the time of NNI's creation, Lane served as assistant to the president of the United States for science and technology and director of the U.S. Office of Science and Technology Policy. He said Smalley played a crucial role in getting the initiative approved, both by President Clinton and by Congress. Smalley's testimony on Capitol Hill, in particular, helped establish him as one of leading U.S. voices for nanotechnology.

"Rick overwhelmingly carried the day," said Caltech's James Heath, one of Smalley's Ph.D. students on the buckyball discovery, who has himself risen to become a leading voice for nanotechnology. "He sat there in front of Congress with no hair, as a result of the chemotherapy, and talked about the promise of nanotechnology for cancer and other diseases and how it would pay off for his children. It was absolutely riveting. Even the text is riveting, but to have been a member of Congress listening to it must have been something else.

"Rick was, more than anybody else, a Moses for the field. Without a Moses, there's no trip to the promised land," Heath said.

At the request of U.S. Sen. Kay Bailey Hutchison, one of Smalley's longstanding supporters in Washington, a prayer for Smalley and his family was offered by the Senate chaplain this morning at the Capitol.

Smalley's fervent belief that nanotubes were a wonder material that could solve some of humanity's most intractable problems -- such as clean energy, clean water and economical space travel -- led him to crusade for more public support for science and to take up the mantle of business after more than three decades in the laboratory.

Smalley helped found Carbon Nanotechnologies Inc. in 2000 to make sure his discoveries made it to the marketplace where they could benefit society. In particular, Smalley was convinced that nanotubes could only be used to solve society's problems if they were manufactured in bulk and processed economically.

In 2002, Smalley embarked upon a two-year crusade to promote the use of nanotechnology to solve what he described as the No. 1 problem facing humanity in the 21 st century -- the need for cheap, clean energy. Smalley crisscrossed the country, gave dozens of keynote addresses, testified before Congress and met with countless government, academic and industrial leaders.

"Rick cared little about honors and much more about how applications of nanoscience might help resolve pressing human problems in energy accessibility, food supplies and medical diagnosis and treatment," said Malcolm Gillis, University Professor, the Ervin Kenneth Zingler

Professor of Economics and professor of management at Rice. "In meetings with Rick in the past year, it was clear to me his primary reasons for his dogged, determined battle against his disease had first to do with his family and second with his desire to witness at least a few of the social benefits he expected from buckyballs, buckytubes and other nanoparticles."

Smalley was born June 6, 1943, in Akron, Ohio, and spent most of his youth in Kansas City. He was the youngest of four children. The childhood influences he credited most for his success were his mother's love of science, the skills she imparted in draftsmanship, his father's tenacity and mechanical abilities and the inspirational example of his aunt, who was one of the first women in the country to earn a Ph.D. in chemistry.

Inspired to science by the launch of Sputnik in 1957, Smalley said he first became serious about education at the age of 16. In an autobiography written for the Nobel committee in 1996, Smalley also credited his high school chemistry teacher, Victor Gustafson, as a key inspiration.

"[Chemistry] was the first class I had ever taken with my sister Linda, who was a year older than I, and was a far better student than I had ever been," Smalley said. "The result was that by the end of the year, my sister and I finished with the top two grades in the class. We hardly ever missed a question on an exam.

"It was an exhilarating experience for me and still ranks as the single most important turning point in my life, even from my current perspective of nearly four decades later."

At his aunt's urging, Smalley enrolled as a chemistry major at Hope College in Holland, Mich., in 1961. He transferred to the University of

Michigan two years later, earning his bachelor's degree in 1965. Smalley began his Ph.D. studies at Princeton in 1969 following four years work at Shell Chemical Co. in New Jersey and the birth of his eldest son, Chad. His studies in the Princeton laboratory of Elliot R. Bernstein marked Smalley's first exposure to the discipline of chemical physics, and Smalley said he learned from Bernstein "a penetrating, intense style of research that I had never known before."

Smalley came to Rice as an assistant professor in 1976 following three years of postdoctoral research at the University of Chicago under Donald H. Levy.

Lane said Smalley rapidly became "a major intellectual force" in chemistry and chemical physics at Rice, helping to found the Rice Quantum Institute in 1979. He was named the Gene and Norman Hackerman Chair in Chemistry in 1982 and was appointed a professor of physics in 1990.

"Rick made great contributions to science," Curl said. "While fullerenes and nanotubes dominated the end of his research career, he had made many contributions of towering magnitude before them."

Smalley was the pivotal force in the development of nanoscience and technology at Rice. He foresaw the potential of the discoveries emerging at this scale and moved with characteristic intensity to forge Rice's program as the founding director of the Center for Nanoscale Science and Technology (CNST). His efforts resulted in the construction of Dell Butcher Hall and the endowment of chairs and the recruitment of faculty pursuing nano-related research in departments throughout science and engineering. Indeed, almost a quarter of Rice's faculty hires in science and engineering since 1985 have expertise relevant to nanoscale science and technology, and innumerable others have incorporated this area into their research agenda. This robust and enthusiastic community will continue the tradition of excellence and vision that Smalley initiated almost two decades ago.

"I think of Rick as the father of nanotechnology in the sense that, better than anyone else, he articulated the vision of its future and how it would impact the world, and he did so in a kind of universal language which was understandable and inspiring to everyone," said William Barnett, trustee emeritus and former chair of the Rice Board of Trustees.

Throughout his career, Smalley maintained a strong commitment to teaching and public service. For example, Smalley still taught undergraduate chemistry in the fall of 1996 when the Nobel Prize was announced.

"One key thing I learned from Rick that I try to teach my students is that we are here doing science because the taxpayers have given us a license to do that," Heath said. "We need to do great science that can change the world we live in, and we need to be sure that we can always explain to the average nonscientist on the street why their investment is worthwhile."

Even while battling cancer, Smalley maintained a hectic work and travel schedule and an intense focus on his research. As director of the Carbon Nanotechnology Laboratory, he continued to develop foundational technologies for carbon nanotube production and processing.

One of Smalley's most ambitious programs, the "Armchair Quantum Wire" project, was begun in April with $11 million funding from NASA.

Smalley described the quantum wire during his acceptance of the Distinguished Alumni Award from Hope College in May, calling it "a continuous cable of buckytubes that we expect will conduct electricity

10 times better than copper yet have only one-sixth the weight, a zero coefficient of thermal expansion, and a tensile strength greater than steel. If we succeed, we'll be able to rewire the world, replacing aluminum and copper in virtually every application and permitting a vast increase in the capacity of the nation's electrical grid."

Smalley was a member of the National Academy of Sciences, a fellow of the American Academy of Arts and Science, the American Physical Society and the American Association for the Advancement of Science.

He was the recipient of countless honors, including the Lifetime Achievement Award from Small Times magazine (2003), the Glenn T. Seaborg Medal from UCLA (2002), the American Carbon Society Medal (1997), the Franklin Medal from the Committee on Science and the Arts of The Franklin Institute (1996), Hewlett-Packard Europhysics Prize from the European Physical Society (1994), the Welch Award in Chemistry from the Robert A. Welch Foundation (1992), Ernest O. Lawrence Memorial Award from the U.S. Department of Energy (1992) and the Irving Langmuir Prize in Chemical Physics from the American Physical Society (1991).

While the Nobel Prize won him worldwide recognition, the award carried a special significance for members of the Rice community because it resulted directly from work carried out on the campus.

"When Rick and Bob won the Nobel Prize, it broke a boundary and forever changed the way people think about Rice," said James Crownover, chair of the Rice Board of Trustees. "With that achievement, they showed that with imagination, inspiration and commitment, there are no boundaries to what Rice and its people can accomplish."

From the moment of their discovery, buckyballs attracted scientific attention worldwide. Carbon, after all, was believed to be one of the most stable of all elements, with two primary forms -- graphite and diamond. The discovery of a third form was astounding to many, and it presaged the dawning of a new era in the physical sciences in which scientists could exert an unprecedented level of control over materials.

Shaped like soccerballs and no wider than a strand of DNA, buckyballs are molecules of pure carbon. Each contains 60 carbon atoms arranged in a hollow sphere. The atomic arrangement of the carbon atoms in buckyballs resembles two conjoined geodesic domes, and Smalley coined the name "buckminsterfullerene" in honor of famed architect and geodesic dome inventor Buckminster Fuller.

Smalley was fond of pointing out that the machinery of life itself, at the most basic level of DNA and protein encoding, draws its power from controlling matter with atomic precision. He coined the term "wet" nanotechnology to apply to the biological systems that operate at the nanoscale and "dry" nanotechnology to the physical/chemical systems that nanotechnologists were developing. At one point in the early years following the discovery of buckyballs, he said that biology was the only working nanotechnology. His vision was to work at the interface between these wet and dry systems -- the wet/dry interface -- to bring the range of systems that could be generated in the dry realm to bear on the wet world of biology and to create entirely new systems.

"Rick could focus so completely on his goals, and he could inspire his students and his colleagues to a similar focus," said Kathleen Matthews, dean of the Wiess School of Natural Sciences and the Stewart Memorial Professor of Biochemistry. "He had the ability to persuade others with a rare intensity of thought and spirit. He brought both passion and intellect to his work, and he displayed a degree of dedication and engagement that could motivate others to new levels of achievement."

Similar words were echoed by Curl: "Rick was a visionary, and his charisma and logic made those he worked with buy into the vision. Rick convinced us that we could be better, stronger and take more chances if we just tried. I hope that we don't forget -- then his legacy to Rice will make a lasting transformative difference."

Source: Rice University

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