Catch a Rising

As he speaks to groups of people about building research across the University, Jim Coleman is wont to make his point using a sports analogy:

"How many of you play basketball?" asks Coleman, vice provost for research. In most audiences, several people raise their hands at this point.

"So, do you think Michael Jordan is worried about you breaking his records?" he continues. Everybody laughs. "You have to compete for the Michael Jordans of the research world."

In recent years, MU has recruited several top researchers, among them the three mentioned in this story. They include Sanjeev Khanna and Shuqun Zhang, who recently won National Science Foundation CAREER grants, an honor Coleman likens to being named rookie of the year.

Coleman also has high praise for an up-and-coming biological engineering faculty member: "Sheila Grant is a perfect example of someone who is merging life sciences with engineering research. All these people bring incredible passion for both their research and integrating that research for students."

Good people want to work with good people. When researchers of this caliber arrive on campus, they can create a ripple effect, Coleman says. "With every good hire, the University's ability to recruit other strong researchers grows."

Star

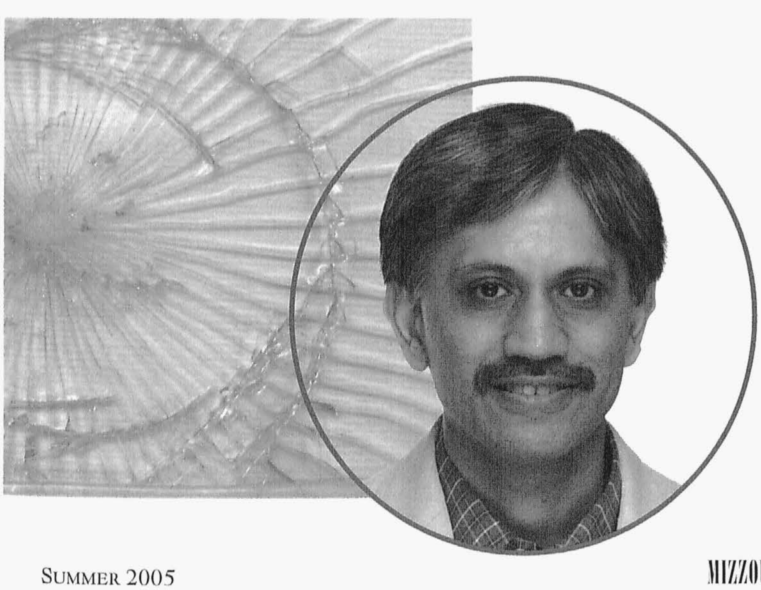
STORY BY DALE SMITH
PHOTOS BY STEVE MORSE

Hurricane-Proof Glass

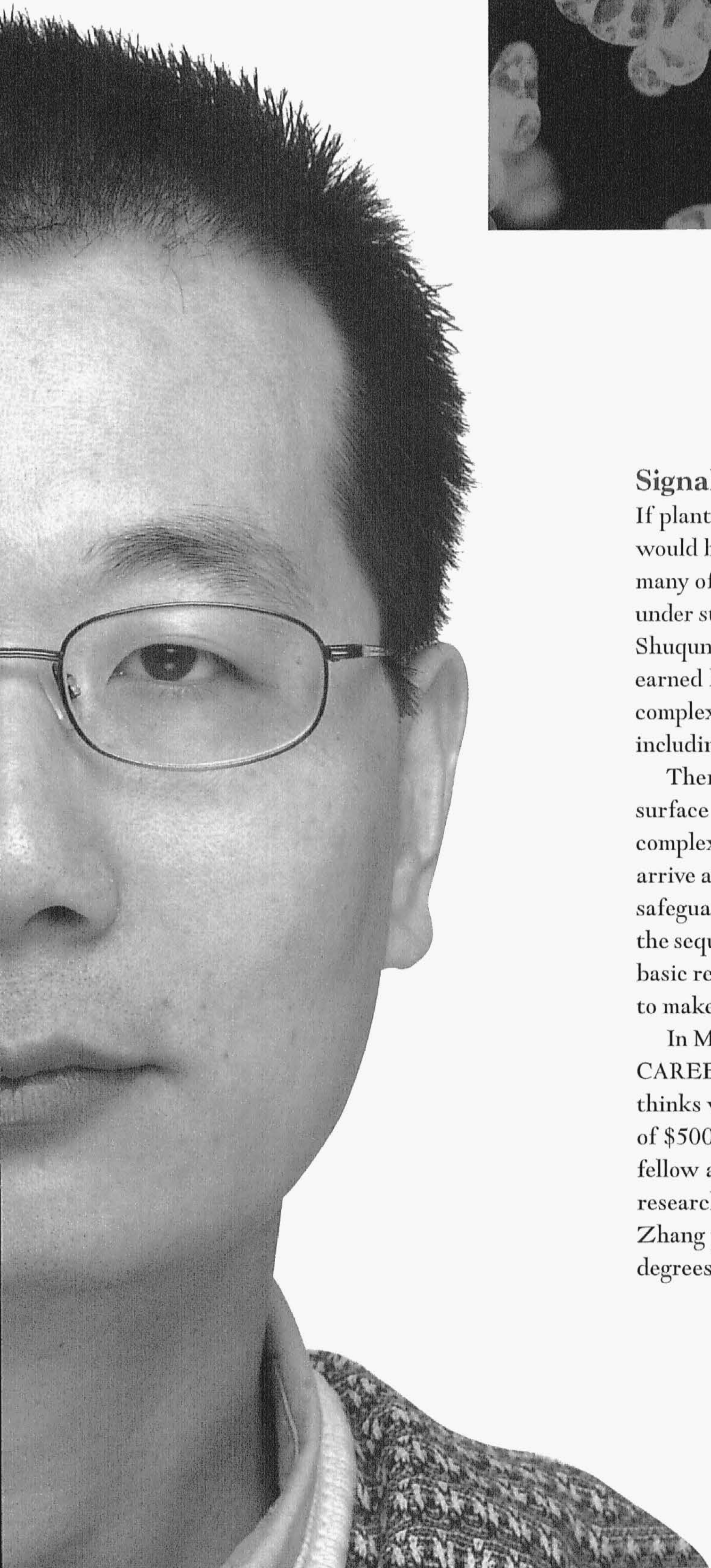
In parts of the world such as Florida, where hurricanes seem to roll around as regularly as national holidays, gravel and other projectiles frequently fly through the air at 60 mph and faster. In these places, the need for better windows goes far beyond aesthetics and R-values to grave concerns for safety and cost. In response to this need, Sanjeev Khanna, associate professor of mechanical and aerospace engineering, is working on what may turn out to be the next state-of-the-art safety glass.

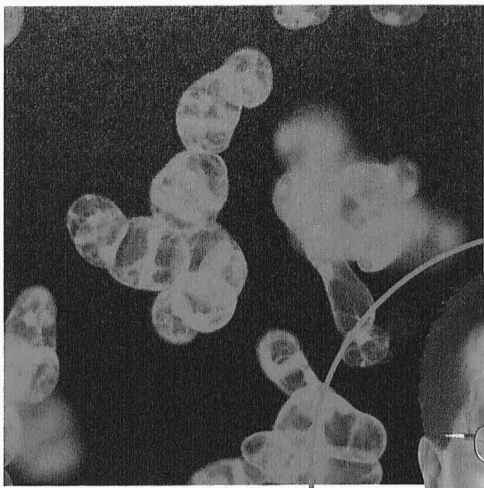
The glass that builders now use is a sandwich of sheet plastic between panes of heat-treated glazing. Khanna's glass is similar, but with one key twist. Its middle layer is made of crisscrossed glass fibers embedded in plastic. The web of glass fibers spreads and attenuates the force of impacts so that the glass is more likely to remain intact during storms. Khanna says it would cost about the same to manufacture as current safety glass but would be cheaper in the long run when fewer panes break during storms.

To test the invention, Khanna and Vijai Venkata, MS '04, used a compressed-air gun to fire metal slugs at both types of glass at varying speeds. Both performed the same until the slug speed reached 65 mph, at which point the current glass failed. Khanna's experimental glass withstood repeated impacts of up to 90 mph. The results have encouraged him to continue improving his experimental glass, whose weakness is that it is less transparent than the current commercial product. Even more extreme tests of strength remain, he says. To gain government approval, the glass must not shatter when hit by an 8-foot wall stud traveling at 30 mph. Stay tuned.



Sanjeev Khanna is working on the next generation of safety glass.





Shuqun Zhang's basic research on plant signaling has garnered international attention.

Signals for Survival

If plants had brains, they'd be single-minded, indeed. Their mantra would be "survive and reproduce." But plants don't use, or express, many of their genes until absolutely necessary, such as when they are under stress. The ability of genes to hibernate saves precious energy, says Shuqun Zhang, associate professor of biochemistry. Zhang recently earned high praise in the scientific community for his studies of the complex internal signals plants send when they are subject to stress, including extreme heat or cold, viruses or ultraviolet light.

There's plenty left to learn. For instance, scientists know that surface receptors detect harmful things and that the receptors set off complex biochemical signals along pathways to the nucleus. Once signals arrive at the nucleus, additional genes can come out of hibernation to safeguard the plant. Although researchers have the general outline of the sequence, Zhang and others are still working out the details. It's basic research that could pay huge dividends if they can figure out how to make crops more resistant to stress.

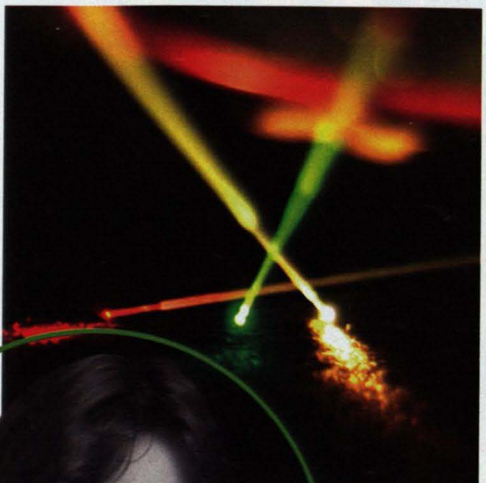
In March 2002, Zhang won a National Science Foundation CAREER grant, which the foundation gives to a few teacher-scholars it thinks will be the next generation of academic leaders. Zhang's award of $500,000 over five years funds the employment of a postdoctoral fellow and two undergraduate students. They help perform the research and, with Zhang's help, learn a lot of science along the way. Zhang predicts those undergraduates will go on to complete advanced degrees and perhaps make discoveries of their own someday.

Super Sensors

When it comes to her work, Sheila Grant has been known to FRET — fluorescence resonance energy transfer, that is. She used the technique in some of the many sensing devices she worked on during her tenure at Lawrence Livermore National Laboratory near San Francisco, and now she uses it in MU's Biosensors and Biomaterials Research Laboratory in the biological engineering department. Grant's projects include developing a range of sensors for anything from spotting early signs of heart attacks to detecting an enzyme that indicates the tenderness of meat. Others could take on homeland security tasks such as detecting poison gas or agro-terror agents that could devastate crops.

At the core of the FRET technique is a tiny glass fiber. Grant fixes a biological sensing agent to the fiber's tip, along with fluorescent dye. She chooses a sensing agent that will interact with whatever she wants to detect, say Troponin-T, an early marker of heart attacks. When Troponin-T touches the agent and interacts, the fluorescent dye reacts, as well. The dye's light travels down the glass fiber, where photo-multiplier tubes convert it into an electric signal and send it to a computer, which turns out numbers that researchers, doctors and patients can use.

Grant envisions that surgeons someday will implant such sensors near the heart, though she and her colleagues from disciplines across campus must first figure out how to make a sensor that the human body won't reject. In her various projects, she works with researchers in medicine, veterinary medicine, physiology and chemistry, as well as engineering. "Biological engineering is fundamentally a multidisciplinary area," Grant says, noting that her doctoral students will graduate with plenty of knowledge in biology, engineering and sensing devices — a marketable constellation of skills in a field that's changing extraordinarily fast. "There's no textbook for what we do," she says. ❋



Sheila Grant's research on biosensors has applications in health care and homeland security.