



# SHAPING THE FUTURE OF MATERIALS TECHNOLOGY

AT TESLA MOTORS AND SPACEX, **CHARLIE KUEHMANN** (PHD '94) IS DRIVING MATERIALS ENGINEERING INTO THE FUTURE.

Like most kids growing up during the era of NASA's Apollo space program, Charlie Kuehmann wanted to be an astronaut. He remembers sitting in front of the television as a five-year-old, watching Americans launch into outer space and knowing that he wanted to be part of that. But when he lost fingers on one hand in a childhood accident, he feared the dream might end.

"Back then, all the astronauts were Air Force pilots, and I knew that [my physical limitations] would keep me out of it," he shares.

"So I thought, OK, if I'm not going to be an astronaut, then I want to build the rockets that go up there."

From that point on, he knew his calling was to be an aerospace engineer. "I just kept going for it, and it worked out pretty well," he says.

Today, as vice president of materials engineering at SpaceX and Tesla Motors, Kuehmann drives development of materials innovations that could one day help enable the commercialization of space and the colonization of other planets. Each time SpaceX launches a new rocket, he and his team study how well it worked, reviewing what was successful and fixing what wasn't.

"I'm sure that's what the Apollo program engineers were all about," he says. "Today we're putting together stuff and making sure it works, just like I'm sure they did back then. It's really incredible."

## FOCUSING ON THE GOAL

Looking beyond successes and setbacks to stay focused on what you want to achieve is a lesson Kuehmann learned at Northwestern while earning a PhD in materials science and engineering. But he first began to think about materials while interning at Honeywell and General Dynamics as an aerospace engineering undergraduate at Arizona State University.

"In each of the projects I worked on, success depended on how the materials performed," he remembers. "I thought if you could push the performance of the materials, it was a really big knob to turn to improve what you were designing."

One of his ASU advisers, a Northwestern alumnus, recommended he check out Northwestern's programs. After earning a National Science Foundation graduate research fellowship, he decided to pursue a PhD.

"I picked Northwestern because when I talked to the professors, I really enjoyed how collaborative they were," he recalls. "It seemed like the projects were more broad-based and interesting."

One of the professors he worked closely with was Gregory Olson, Walter P. Murphy Professor of Materials Science and Engineering. Dubbed the "father of materials design" by the American Academy of Arts and Sciences, Olson had come to Northwestern from MIT just as Kuehmann started. The two discussed Olson's vision for using computational modeling to improve materials design. This struck a chord with Kuehmann, who had experience in design and computational modeling for aerospace systems.

"I felt that was something I could bring to the table, and at the same time I could learn a tremendous amount from this guy who was brilliant in materials science and thought about materials in a way that was pretty unique," he says.

When Olson asked him to grab a beer while they talked about the topic, Kuehmann knew they would collaborate well. "If you're going to spend five years on your PhD, you better find somebody you enjoy working with," he laughs. "I realized he was somebody I could deal with for a long time, but I didn't know *how long* I was getting in for."



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## MATERIALS BY DESIGN

The two ended up working together for 18 years after founding QuesTek Innovations, an integrated computational materials engineering firm, in 1996. They used the revenue stream from an engineering and technical services company Kuehmann had started as an entrepreneurial-minded undergraduate to help fund QuesTek, combining the two companies.

"Charlie was an unusual student," Olson says. "He entered materials science graduate studies with a strong background in engineering design through his undergrad studies in aerospace engineering and his prior entrepreneurial experience. He was the perfect candidate to commercialize the materials design technology his doctoral studies helped create."

QuesTek used proprietary expertise to rapidly design, develop, and insert new materials with specific properties to reduce costs and improve performance. Clients included Newman/Haas Racing, the US Navy, and SpaceX. Kuehmann served as QuesTek's CEO until he and Olson sold the company to an unnamed buyer in 2012.

While Kuehmann continued to serve on QuesTek's board of directors, he moved on to become director of product design at Apple Inc., where he headed up a materials engineering team that worked across product lines. Going from running his own company to working for a major brand was a big change, but he says the atmosphere at Apple was very entrepreneurial, and the job was essentially the same.

"My product was no longer the main product, but in a lot of ways it wasn't that much different," he explains. "It was building a team to do a particular job."

## A HIGHER CALLING

Kuehmann enjoyed the role at Apple, but the kid inside him still wanted to make rockets. At QuesTek, he'd worked with SpaceX's engine propulsion team, and although he didn't meet Elon Musk, the Tesla Motors and SpaceX founder and CEO had heard good things about Kuehmann's work. One day, Musk called him.

"Elon has always been a strong supporter of advanced materials," Kuehmann says. "He's very much an engineer and recognizes how much materials have to play in that, so he was thinking about upping their game. We talked about it, and it became clear that both Tesla and SpaceX need a design-centered approach for materials. It made a lot of sense that I lead both sides of the fence."

At Apple, Kuehmann helped create products that impact people's daily lives. At Tesla and SpaceX, he's making products that he hopes "will lead to human achievements that people will talk about forever," much like the Apollo missions. He thanks Northwestern for his involvement in shaping new materials technology that was 20 years ahead of its time. He stays connected, often speaking to students and serving on the advisory board of Olson's research group in the Materials Technology Laboratory.

"The government's Materials Genome Initiative is basically saying what we did 20 years ago at Northwestern is the future of the way materials are going to be engineered," he says. "Every day, I'm creating what I learned at Northwestern in new organizations, and that's really satisfying."

SARA LANGEN