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Married to their research–and to each other

Husband-and-wife team brings 'smart skin' expertise to growing NanoFab facility

Domestic dialogue in the Celik-Butler household takes on a diverse quality that can range from the mundane to leading-edge nanoscience.

Zeynep Celik-Butler and husband Don Butler are exploring "smart skin" technology that has far-reaching potential, from noninvasive medical monitoring and environmental sensing to industrial testing and national defense. The National Science Foundation has awarded their project a three-year grant.

Maybe it's summer camp possibilities for the two daughters. Or some snag in the development of infrared detectors. Or maybe a new wrinkle in reducing noise in the next generation of cell phones or computers.

The world-renowned husband-and-wife professor team of Don Butler and Zeynep Celik-Butler brings an all-in-the-family dynamic to UTA and its burgeoning NanoFab laboratory.

Don, a Canadian, runs the Microsensors Laboratory at the University's Nanotechnology Research & Teaching Facility (NanoFab), while Zeynep, originally from Turkey, directs the facility's Noise and Reliability Laboratories.

Don Butler and Zeynep Celik-Butler are researching sensors that, if adequately developed, could help eliminate sudden infant death syndrome or enable monitoring

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of people with a variety of health-related problems. Their work could also result in a cell phone that folds up like a stick of gum.

Drs. Butler and Celik-Butler collaborate on some research projects and work independently on others. Strictly speaking, the pair are not nanoscientists but researchers in micro-electromechanical systems (MEMS). Much of their work, however, constitutes a synergistic bridge between MEMS and nanoelectronics. MEMS involves very small micron scale while nano applications can be measured in billionths.

The research team has gained international recognition to the point that the pair received a three-year, $300,000 National Science Foundation research grant in so-called “smart skin” technology. The research scientists use the word “skin” only for lack of a better term. The technical word for smart skin is distributed flexible microsensor array.

“It’s not meant to be human skin,” Dr. Celik-Butler explains. “It doesn’t have to actually be touching a surface to detect temperature variance, though the distances can range from very close to a kilometer or more.”

Such technology has far-reaching potential, from noninvasive medical (physiological) monitoring and environmental sensing to industrial testing and national defense. The researchers hope that in time smart skin advances will expand to areas other than temperature fluctuations, such as determining differences in texture, density or pressure.

“Smart skin sensors can be built on rigid silicon substrate to micron scale, as well as on flexible polymers,” Dr. Zeynep Celik-Butler said. “In addition to sensitivity, we want the material to be flexible—to bend and stretch in whatever shape we want.”

The Butlers are electrical engineers and physicists, not chemists, so they’re collaborating with chemistry professors to develop more efficient polymers that will support their smart skin technology.

“The sensors’ ability to flex will allow them to be used in many future applications,” Dr. Celik-Butler said. Such technology down the road could result in a cell phone that folds up like a stick of gum or compacts to the size of a stubby pencil.

The range of possibilities is immense. The team is considering putting sensors in gloves and gripping mechanisms of robotic machines. The person operating the robot could then have a sense of touch adjusted for the realities of the robotic environment. Think of it as hands-on, but from afar.

Or sensors could be installed unobtrusively in clothing ranging from infant wear to military apparel, providing ongoing monitoring of the vital signs of the person wearing it. Adequately developed, the technology may help eliminate such problems as sudden infant death syndrome or enable

monitoring people with a variety of health problems.

When she isn't working on smart skin projects, Dr. Celik-Butler focuses on an unrelated research grant funded by the Semiconductor Research Corp. and supported by companies such as ST-Microelectronics, Legerity, Texas Instruments and Motorola. As wireless communications devices and landline applications get smaller, the signal-to-noise ratio increases. The quality of high-speed transmissions is degraded by the inherent qualities of the devices involved.

"In the simplest sense, what we're trying to do is decrease noise and increase reliability, finding technologies that will end up making your cell phone and lots of other transmissions cleaner and faster," she said.

For the Butlers, collaboration with other scientists—and with each other—is a crucial component of the creative process. Shop talk doesn't stop at the shop.

"Depending on circumstances, we talk a little or a lot about our work at home," Dr. Butler said. "We work anywhere and everywhere. We never say let's never talk about work because it's what we really find most interesting. We come up with some of our best ideas when we're not actually supposed to be working."

The Butlers have found UTA and the Metroplex ideal environments for their style of research.

"This is a great place to be doing what we're doing," Dr. Celik-Butler said. "Think of all the high-tech companies here to work with, get contracts from. In our industry, why would you want to be somewhere else?"

Her husband agrees. "It's obvious that we're big believers in collaboration, and that's been one of the big benefits of being here at UTA. There's incredible strength in engineering and sciences. We collaborate with them, they with us, and we all benefit. They take what we're thinking, use it, then come back with refinements, which we then use ourselves. Science is no place to be jealous."

At home. At work. For the Butlers, collaboration is the name of the game, a merge-the-minds philosophy aimed at providing significant technological advances for society—and an even higher level of recognition for them and the University.

by O.K. Carter