



“My research aims to meet people’s needs, to help them have healthier lives and make our nation more secure.”

- Dr. Wei Chen

Taking a shine to treatment

Physicist Wei Chen is also shedding light, literally, on nanoparticle therapy research.

Like Nguyen, he is interested in targeted nanoparticles, specifically chemotherapy drugs for breast cancer. He wants to develop a process during which the release of medications can be turned on and off, typically in tandem with exposure to a spectrum of light.

“All the nanoparticles made in my group have luminescence,” he explains. “I call it nanoparticle fluorescence-based technology.”

Traditional medical science tends to view fluorescence as an application of medical imaging—it helps physicians see inside our bodies. By utilizing nanoparticles infused with medication, such as photodynamic drugs, Chen expands the technology to

release drugs only in the diseased area.

The light illuminates the nanoparticles, which then transfer their energy to activate the drugs so they will produce toxins like singlet oxygen for tumor cell destruction. The toxins would be generated in only the area receiving the light, and that release would stop when the light was turned off.

“This is the beauty of photodynamic therapy for cancer treatment,” Chen says. “Even if the drug is in the tissue, it would not have any effect until it is activated by light. This gives us two ways to control

the treatment. The first is targeting the drug, and the second is focusing the light (radiation). A safer treatment will result, and side effects can be avoided.”

Photodynamic therapy has proved successful for some types of skin cancers, but there’s an obvious challenge for deep cancer treatment: How does the light to activate the drugs get inside the body?

“In the nanoparticle-based photodynamic treatment I propose, the light is actually provided by a radiation source like an X-ray that can penetrate deeply into the body,” Chen says. He also has created “afterglow nanoparticles” within which luminescence lasts awhile after the excitation is off.

Afterglow materials have been used for emergency lighting, but Chen envisions a more lasting drug activation. Department of Defense congressionally directed medical research programs are funding this work.

Chen is examining how to combine photodynamic therapy and radiation therapy in a targeted yet flexible way, to lessen the problems associated with full-body drug treatment. And he sees another benefit. “I believe that when the particular type of therapy is refined, we can also reduce the radiation dose.”

Lessened chemotherapy side effects and fewer consequences of radiation treatments have enormous appeal to the medical industry and cancer patients.

“For much radiation therapy, patients must receive a very high dose for it to be effective,” Chen says.

“Radiation can damage healthy tissue, so we need to keep the dose as low as possible.”

The technique also offers hope for attacking tumors deep inside the body. It likely will be four to five years before the first trial projects on a few select human patients can be implemented.

“Because it involves people’s health and the practice of medicine, it has to be very painstaking research,” Chen says. “Unfortunately, it’s not easy to really speed up the timeline.”

Not that there isn’t pressure to do so. Chen has received requests from desperate people volunteering to take the experimental treatment. But it’s far too early for that, with animal trials yet to come.

An eye on safety

In the meantime, Chen’s nanoparticle fluorescence has ramifications from battling cataracts to detecting uranium shipments.

"We're working on delivering drugs that kill cataracts," he says. "Right now all the treatments are intrusive with either surgery or lasers."

Cataracts affect 20.5 million people in the United States, and one out of five people over age 75 will have a cataract procedure. The federal government spends \$3.4 billion in Medicare costs each year for cataract surgeries.

"There are hundreds of thousands of cataract surgeries around the country," Chen says. "It's a problem essentially caused by slow oxidation of protein, with the lens slowly becoming foggy."

The UT Arlington researcher proposes custom-designed nanoparticles that have a chemical attraction to the cataract. Flooding the eye with light would activate the treatment chemical. He is collaborating with Barbara Pierscionek in Vision Science at the University of Ulster and Ron Schachar, an adjunct physics professor at UT Arlington and a senior director of ophthalmology at Pfizer Corp.

Chen believes that cataracts could either be stopped or slowed so dramatically that surgery would not be necessary. Patients would just need an occasional nanoparticle fluorescence treatment.

An unexpected side benefit to the fluorescence research involves a Department of Homeland Security grant that would use the technology to detect shipments of uranium or other radioactive materials, critical concerns because of their potential use in nuclear terrorism.

"When I read that Homeland Security was looking for science to help in this kind of detection, it seemed obvious that a version of what we're doing with fluorescence might well give them what they need, though we'd be reversing the process."

Chen says the idea is that high radiation levels would cause custom-designed nanoparticles to "light up."

"Though there are many variables involved, I believe this can be accomplished with considerable efficiency and reliability, and at a relatively low cost," he says.

The research will be conducted in collaboration with UT Arlington high-energy physicist Andrew Brandt and Alan Joly at Pacific Northwest National Laboratory.

Chen's work has been a veritable grant magnet. Before joining UT Arlington, he worked six years at ICx Nomadics as a group leader and leading nanotechnology scientist. He has received 10 Small Business

Innovation Research/Small Business Technology Transfer grants with total funding of \$3.5 million.

"I am a practical guy," he says. "My research aims to meet people's needs, to help them have healthier lives and make our nation more secure."

Though it may be a decade before their research becomes standard practice, Kytai Nguyen and Wei Chen are bold explorers in a world of experimental medicine where few have ventured.

- O.K. Carter

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