Magnet Lab Researcher Exploring Science Behind Commercial Applications of Liquid Helium

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Picture a teaspoon of powdered sugar. As fine a substance as it is, there still are tremendous differences in the sizes of its individual particles. Some are so small, they move around randomly and are invisible to the naked eye.
Now, let's say you wanted to choose only particles of a certain size from those in the spoon.

Traditional technology and scientific techniques can separate quantities of particles of different sizes down to a few microns, but beyond that, it's not currently possible to perform this operation at the submicron level. Being able to do so would allow for the production of certain types of drugs that are most effective when inhaled.

How small is a submicron? Consider that a micron is a mere 0.00004 of an inch. Yet unlocking the mystery of how to manipulate, measure and separate very tiny particles has tremendous applications for the pharmaceutical industry and could change how some medications are delivered and how effective they are.

That's the backdrop for the research of Steven W. Van Sciver, a professor of mechanical engineering with the Florida A&M University/Florida State University College of Engineering and an expert in cryogenics (the study of low-temperature phenomena) at the National High Magnetic Field Laboratory in Tallahassee. Van Sciver is working with technology company Oxford Instruments on the first phase of a grant to help prove the concept behind a patent-pending cryogenic technique for particle separation from a few microns down to submicrons.

With funding from Oxford Instruments, Van Sciver is performing the basic science behind how particles behave in liquid helium. Helium turns into liquid only at very low temperatures (minus 452 degrees Fahrenheit, where virtually everything else is frozen solid). If helium is cooled to even lower temperatures, it becomes "superfluid," meaning that if placed in a closed loop it can flow endlessly without friction.

"Superfluid helium has extraordinary properties," said Van Sciver. "Because of its unique viscosity and heat conductivity, its flow can be controlled to a degree you can't get with other fluids. It has lots of potential for commercial applications."

In a letter published in a recent issue of *Nature Physics*, Van Sciver wrote that when superfluid helium flows toward and then around a relatively large object, say the size of a small stone, it has a tendency to create whirlpools not just in the back, as would be expected, but also in the front. So a portion is flowing "counterflow," or in an opposite direction. This is a unique observation and a link in the chain of science that Van Sciver hopes ultimately will lead to development of a cryogenic technique for particle separation.

Toward this end, Van Sciver is moving forward on a research-and-development program funded by Oxford Instruments to establish the operating principles behind a device to separate particles. Proper sizing of particles is critically important for effective "aspiration" delivery of medication; some medications are much better tolerated when absorbed through the lungs rather than through the bloodstream.

"In order to deliver respiratory medications to the deep lung efficiently, careful engineering of the size and density of the microparticles in the drug is essential," said Neal Kalechofsky, technology development manager with Oxford Instruments, a global technology company that provides tools and systems for the physical science and bioscience sectors. "Through our partnership with FSU, we are exploring the extension of low-temperature technology to new applications in microparticle classification."

The National High Magnetic Field Laboratory: www.magnet.fsu.edu

Source: Florida State University

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