Chemists demonstrate nanoscale alloys so bright they could have potential medical applications

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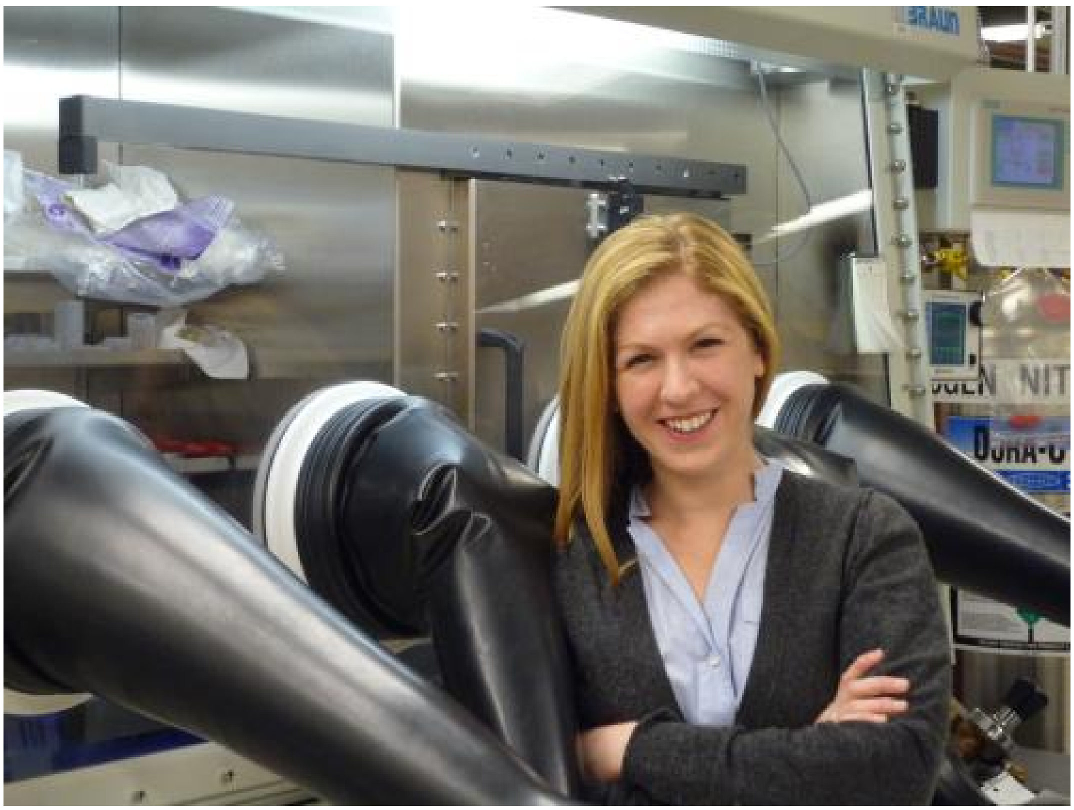

Jill Millstone, University of Pittsburgh, assistant professor of chemistry, demonstrates that nanometer-scale alloys possess the ability to emit light so bright they could have potential applications in medicine. Credit: University of Pittsburgh

(Phys.org) —Alloys like bronze and steel have been transformational for centuries, yielding top-of-the-line machines necessary for industry. As scientists move toward nanotechnology, however, the focus has shifted toward creating alloys at the nanometer scale—producing materials with properties unlike their predecessors.

Now, research at the University of Pittsburgh demonstrates that nanometer-scale alloys possess the ability to emit light so bright they could have potential applications in medicine. The findings have been published in the *Journal of the American Chemical Society*.

"We demonstrate alloys that are some of the brightest, near-infrared-light-emitting species known to date. They are 100 times brighter than what's being used now," said Jill Millstone, principal investigator of the study and assistant professor of chemistry in Pitt's Kenneth P. Dietrich School of Arts and Sciences. "Think about a particle that will not only help researchers detect cancer sooner but be used to treat the tumor, too."

In the paper, Millstone presents alloys with drastically different properties than before—including near-infrared (NIR) light emission —depending on their size, shape, and surface chemistry. NIR is an important region of the light spectrum and is integral to technology found in science and medical settings, said Millstone. She uses a laser pointer as an example.

"If you put your finger over a red laser [which is close to the NIR light region of the spectrum], you'll see the red light shine through. However, if you do the same with a green laser [light in the visible region of the spectrum], your finger will completely block it," said Millstone. "This example shows how the body can absorb visible light well but doesn't absorb red light as well. That means that using NIR emitters to visualize cells and, ultimately parts of the body, is promising for minimally invasive diagnostics."

In addition, Millstone's demonstration is unique in that she was able to show—for the first time—a continuously tunable composition for nanoparticle alloys; this means the ratio of materials can be altered based on need. In traditional metallurgical studies, materials such as steels can be highly tailored toward the application, say, for an airplane wing versus a cooking pot. However, alloys at the nanoscale follow different rules, says Millstone. Because the nanoparticles are so small, the components often don't stay together and instead quickly separate, like oil and vinegar. In her paper, Millstone describes using small organic molecules to "glue" an alloy in place, so that the two components stay mixed. This strategy led to the discovery of NIR luminescence and also paves the way for other types of nanoparticle alloys that are useful not only in imaging, but in applications like catalysis for the industrial-scale conversion of fossil fuels into fine chemicals.

Millstone says that taken together these observations provide a new platform to investigate the structural origins of small metal nanoparticles' photoluminescence and of alloy formation in general. She believes these studies should lead directly to applications in such areas of national need as health and energy.

More information: The paper, "Photoluminescent Gold-Copper Nanoparticle Alloys with Composition-Tunable Near-Infrared Emission," first appeared online April 3 and later in print April 10 in *JACS* (*Journal of the American Chemical Society*).

Provided by University of Pittsburgh