

MATERIALS SCIENCE

Nano-Imaging Feud Sets Online Sites Sizzling

Scientific controversies often sort themselves out as new data roll in. But a decade-old dispute in nanoscience shows no sign of letting up. Researchers on both sides are claiming that recently published papers settle the debate in their favor, while one is charging his opponents with resorting to an electronic bullying campaign.

The clash dates back to a 2004 *Nature Materials* paper in which researchers led by Francesco Stellacci, then at the Massachusetts Institute of Technology (MIT) and now at the Swiss Federal Institute

spot signatures consistent with Stellacci's stripes seals the deal, says Biscarini, a chemist and expert in scanning microscopy. "In my mind the controversy is over."

Stellacci's critics—chiefly U.K.-based STM experts Raphaël Lévy of the University of Liverpool and Philip Moriarty of the University of Nottingham—were quick to respond. All along they have contended that Stellacci and his colleagues made basic mistakes in their imaging studies. For example, they say, the original "stripes" were created by electronic feedback in the STM.

what kids that commit suicide go through." Instead of engaging in such "unethical and unprofessional" conduct, he says, the skeptics should go through the normal channels of peer review and publish their data in journals so the scientific process can work through the issues.

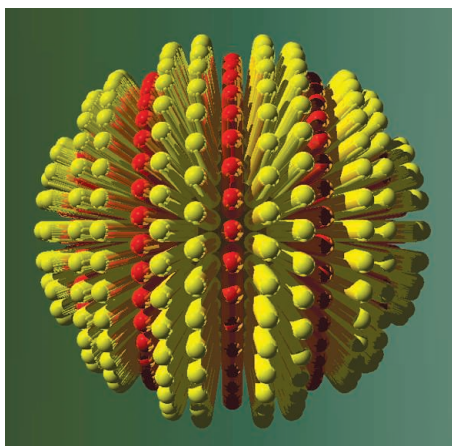
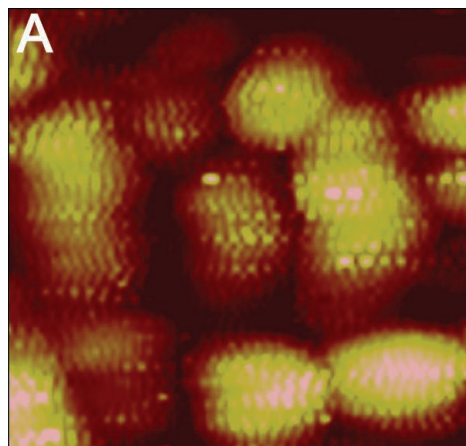
But the critics say their adversarial approach is normal science at work and that researchers should not hide behind the cloak of peer review. "I have no time at all for this argument," Moriarty says. "If you're publicly funded, tough. Get out there and face your critics." He and Lévy say they were forced to go online in this case because the peer-review process was far too slow. Lévy says he had to wait 3 years to get a manuscript published in response to the original *Nature Materials* paper. "It shows there are serious problems with the way science is evaluated [using peer review]," Lévy says. He adds that he has "no personal conflict" with Stellacci and would post unedited any rebuttal or commentary Stellacci cared to send. Stellacci, however, says he refuses to be drawn into an unending scuffle with opponents who misrepresent his work.

Kelly agrees with critics that the stripes in the original paper "look like an imaging artifact," but he and others say the jury is still out on more recent reports. The bottom line, Kelly says, is that trying to take images of stripes just two to three molecules wide on a tiny curved surface pushes the current limits of nanoscience. "They are trying to do a really hard measurement," he says.

As scientific imbroglios go, this one pales beside such once-raging controversies as cold fusion, arsenic-based life, and credit for the discovery of HIV. "This can be seen as a minor storm in a nano teapot," Moriarty acknowledges. But, he says, he feels compelled to respond to prevent mistakes from proliferating through the literature.

Now, Moriarty and Lévy are getting a taste of their own maelstrom: Their recent paper touched off a heated debate on PubPeer, in which a commenter labeled "Unregistered Submission" has repeatedly picked apart their science. Moriarty suspects either Stellacci or one of his students or co-authors. (Stellacci denies any involvement.) "I would prefer to get rid of anonymous comments, and I am glad that Francesco Stellacci and I have that in common," Moriarty says. For now, as the tempest roils on, that's about all they agree on.

—ROBERT F. SERVICE



See anything? An image of gold nanoparticles from a 2004 paper (*left*) showed features that Francesco Stellacci interprets as organic "stripes" (model, *right*) but that critics attribute to STM feedback.

of Technology in Lausanne (EPFL), reported that they had created gold nanoparticles with stripes of two different organic compounds, which the team imaged using a scanning tunneling microscope (STM). Stellacci says such stripes could help nanoparticles enter cells and thus might be useful for delivering medicines or imaging agents. But critics took to blogs, arguing that the stripes were likely artifacts of Stellacci's attempt to image features at the very limit of resolution.

Researchers on the outskirts of the fray are bewildered at the intensity of the dispute, saying the scientific stakes are modest. "I'm stunned at how long this has been going on," says Kevin Kelly, a scanning tunneling microscopist at Rice University in Houston, Texas.

Four pro-stripe papers by Stellacci and other researchers have stoked the debate. Fabio Biscarini of the University of Modena and Reggio Emilia in Italy is the lead author of one, co-authored with Stellacci and published in *Langmuir* late last year. The fact that four labs using a variety of techniques

Now, in an article posted on the arXiv online physics preprint server and submitted to *PLOS ONE*, they charge that the new papers are riddled with cherry-picked images, patterns imposed on what is essentially noise, and other mistakes that undermine the authors' interpretation of the data.

Just as fierce is the metadispute over the way the critics of Stellacci's experiment have waged their campaign. Stellacci notes that his critics have made four formal misconduct charges against him: two to MIT and one each to EPFL and the journal *ACS Nano*. Investigators cleared him in all four cases. What's more, apart from a couple of papers in journals, the critics have posted most of their denunciations online in blogs, on Twitter, and in anonymous comments on the postpublication criticism website PubPeer. Numerous harsh critiques of Stellacci's work, both anonymous and attributed, have appeared on a blog Lévy runs on his research group's website.

"I have been subject to chemical cyber-bullying," Stellacci says. "I understand

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