Microscopy TODAY
Coming Events

2015

Frontiers in Light Microscopy Symposium
November 17, 2015
National Institutes of Health, Bethesda, MD
https://ncifrederick.cancer.gov/events/LightMicroscopy

2015 MRS Fall Meeting & Exhibition
November 29–December 4, 2015
Boston, MA
Sponsor: Materials Research Society (MRS)
www.mrs.org/fall2015

American Society for Cell Biology (ASCB) 2015 Annual Meeting
December 12–16, 2015
San Diego, CA
http://ascb.org/future-ascb-annual-meetings

2016

Physics and Chemistry of Semiconductor Surfaces and Interfaces (PCSI-43)
January 17–21, 2016
Location: Palm Springs, CA
www.pcsiconference.org

24th Australian Conference on Microscopy and Microanalysis
January 31–February 4, 2016
Melbourne, Australia
www.acmm2016.org

Nanoscience and Nanotechnology (ICONN) 2016
February 7–11, 2016
Canberra, Australia
www.ausnano.net/iconn2016

60th Annual Meeting, Biophysical Society
February 27–March 2, 2016
Los Angeles, CA
www.biophysics.org/Meetings/AnnualMeeting/tabid/85/Default.aspx

PITTCON Conference
March 6–10, 2016
Atlanta, GA
http://pittcon.org

2016 MRS Spring Meeting
March 28–April 1, 2016
Phoenix, AZ
www.mrs.org/spring2016

Microscopy & Microanalysis 2016
July 24–28, 2016
Columbus, OH
www.microscopy.org

2017

Microscopy & Microanalysis 2017
July 23–27, 2017
St. Louis, MO
www.microscopy.org

2018

Microscopy & Microanalysis 2018
August 5–9, 2018
Baltimore, MD
www.microscopy.org

2019

Microscopy & Microanalysis 2019
August 4–8, 2019
Portland, OR
www.microscopy.org

2020

Microscopy & Microanalysis 2020
August 2–6, 2020
Milwaukee, WI
www.microscopy.org

More Meetings and Courses
Check the complete calendar near the back of this magazine.

Carmichael's Concise Review

Scanning Electron Microscopy Shows How to Keep Cool in the Desert

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The silver ants of the Sahara desert, *Cataglyphis bombycina*, inhabit a unique ecological niche where their diet consists mainly of the bodies of insects and other arthropods that cannot survive in the heat as well as they can. Recently, Norman Nan Shi, Cheng-Chia Tsai, Fernando Camino, Gary Bernard, Nanfang Yu, and Rüdiger Wehner showed that the secret to the ants' survival is the shape of the hairs that cover much (but not all!) of their bodies.

In addition to thermodynamic measurements, full-wave simulations, and heat-transfer modeling, Shi et al. used scanning electron microscopy to examine the hairs that cover only the top and the sides of the ant's body. They found a dense array of parallel hairs that were triangular in cross section. Interestingly, the two surfaces facing outwards were corrugated, whereas the surface facing the ant's body was flat. The array of hairs was structured so that they reflected visible and near-infrared radiation through phenomena known as Mie scattering and total internal reflection. The hair-covered region reflected 67% of the incoming solar radiation rather than only 41%, as was the case after the hair was removed from the cuticle. There were variations in the hairs' cross-sectional areas, but it was determined that resonance peaks from individual hairs were averaged out so that the hair cover effectively acts as a coating with enhanced broadband reflection in the solar radiation spectrum.

Shi et al. compared reflective properties of triangular and circular hairs of the same cross-sectional area. Even though the reflectance was similar when the incoming solar radiation was normal to the hair-coated surface, triangular hairs produced an extra enhancement of reflectivity at oblique angles of incidence. This is because

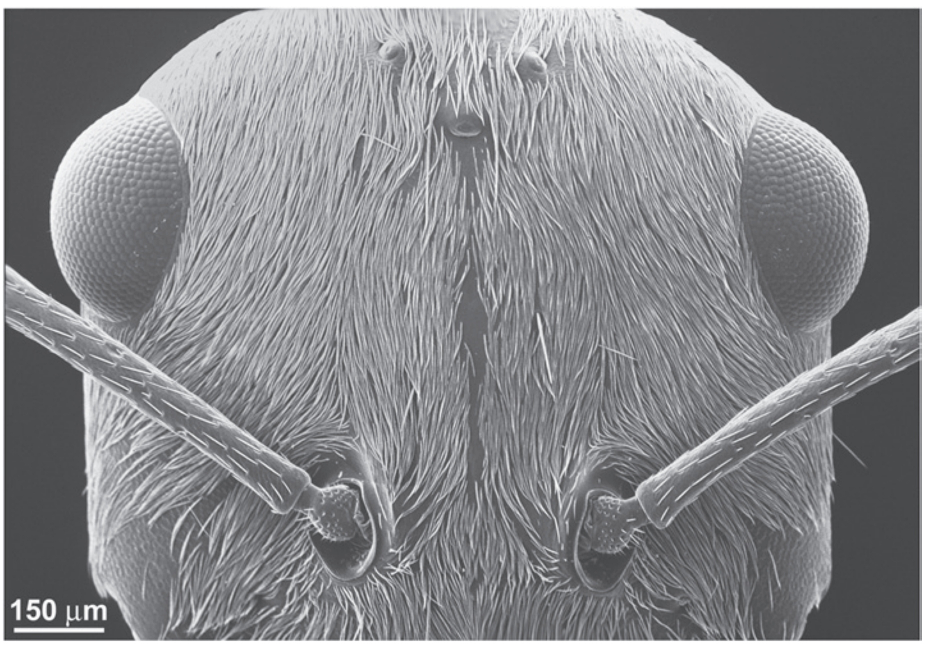
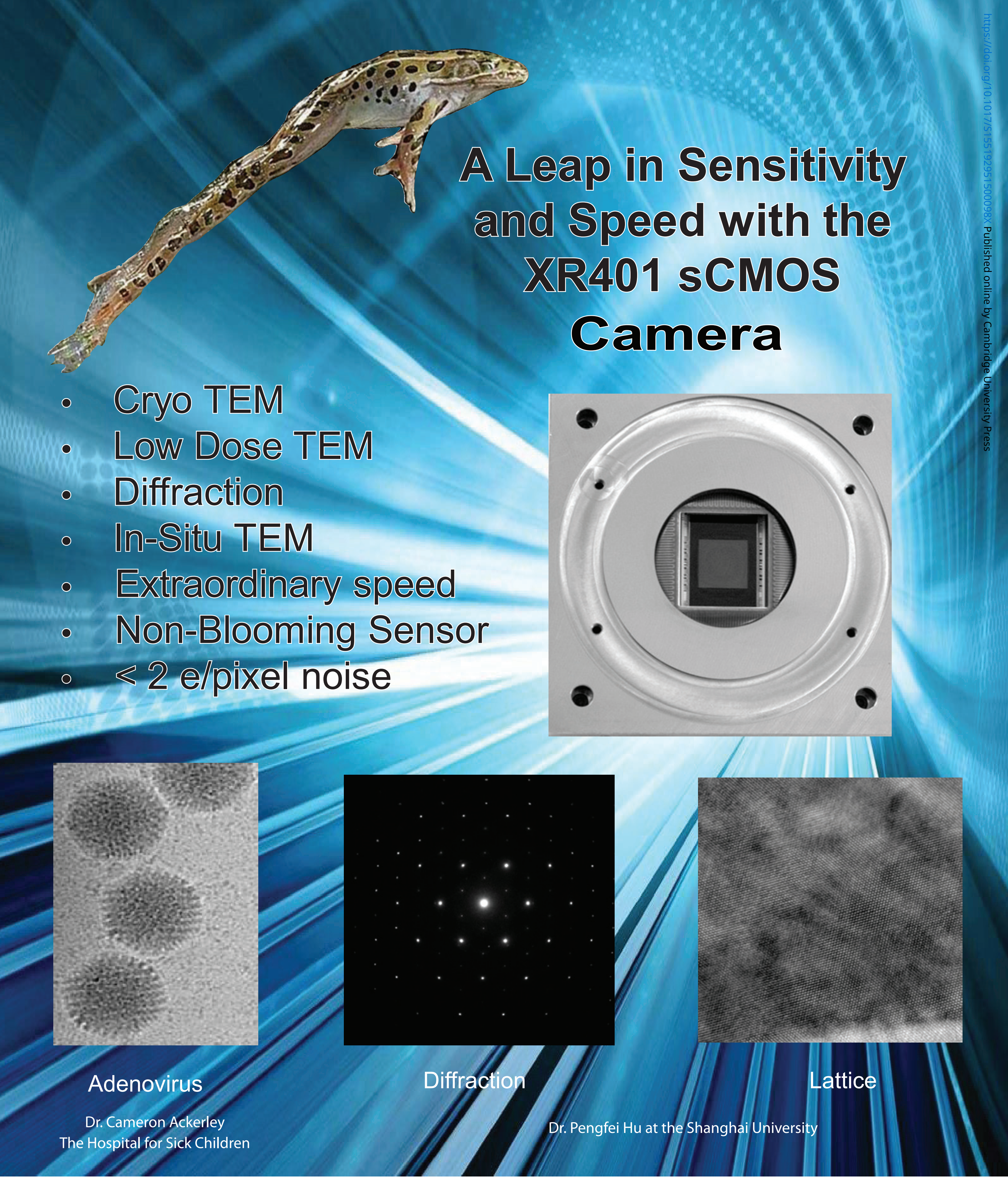


Figure 1: Scanning electron micrograph of the head of a Saharan silver ant.

doi:10.1017/S155192951500098X



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Mie scattering of similar strength occurs in both circular and triangular hairs; in the latter the total internal reflection from the bottom flat surfaces of individual hairs substantially enhances reflectivity.

An equally important function of the hair array in the thermoregulation of the ants is that it enhances emission of heat radiation from the ant's body. Shi et al. showed this in a series of thermodynamic experiments where the efficiencies in dissipating heat as thermal radiation are compared between ants with intact hair covers and with bald surfaces. Furthermore, the hairless bottom surface of the ant was shown to reduce the radiative energy transfer between the hot sand and the cooler ant body so that the animals can reduce the absorption of blackbody radiation from desert floor. This occurs in the mid-infrared range.

The most exciting aspect of these studies is the demonstration that properties of a structured surface, specifically the shape and surface characteristics of hair-like projections, can provide effective passive cooling of objects. This biological solution for a thermoregulatory problem could lead to the development of biomimetic coatings that would be very beneficial!

References

[1] N Shi et al., *Science* 349 (2015) 298–301.

[2] The author gratefully acknowledges Dr. Nanfang Yu for reviewing this article.

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