

### 2017

#### 2017 MRS Fall Meeting

November 26–December 1, 2017  
Boston, MA  
[www.mrs.org/fall2017](http://www.mrs.org/fall2017)

#### American Society for Cell Biology

December 2–6, 2017  
Philadelphia, PA  
<http://ascb.org/future-ascb-annual-meetings>

### 2018

#### Semiconductor Interfaces (PCSI-45)

January 14–18, 2018  
Kona, HI  
<https://pcsi2018.avs.org>

#### Biophysical Society

February 17–21, 2018  
San Francisco, CA  
[www.biophysics.org/Meetings/AnnualMeeting/Future/tabid/495/Default.aspx](http://www.biophysics.org/Meetings/AnnualMeeting/Future/tabid/495/Default.aspx)

#### PITTCON 2018

February 26–March 1, 2018  
Orlando, FL  
<https://pittcon.org>

#### 255th ACS National Meeting

March 18–22, 2018  
New Orleans, LA  
[www.acs.org/content/acs/en/meetings/nationalmeetings/meetings.html](http://www.acs.org/content/acs/en/meetings/nationalmeetings/meetings.html)

#### 2018 MRS Spring Meeting

April 2–6, 2018  
Phoenix, AZ  
[www.mrs.org/spring2018](http://www.mrs.org/spring2018)

#### Histochemistry 2018

April 21–25, 2018  
San Diego, CA  
<http://histochemicalsociety.org/Meetings-and-Courses/Histochemistry-2018.aspx>

#### Microscopy & Microanalysis 2018

August 5–9, 2018  
Baltimore, MD  
[www.microscopy.org](http://www.microscopy.org)

### 2019

#### Microscopy & Microanalysis 2019

August 4–8, 2019  
Portland, OR  
[www.microscopy.org](http://www.microscopy.org)

### 2020

#### Microscopy & Microanalysis 2020

August 2–6, 2020  
Milwaukee, WI  
[www.microscopy.org](http://www.microscopy.org)

### 2021

#### Microscopy & Microanalysis 2021

August 1–5, 2021  
Pittsburgh, PA  
[www.microscopy.org](http://www.microscopy.org)

### 2022

#### Microscopy & Microanalysis 2022

July 31–August 4, 2022  
Portland, OR  
[www.microscopy.org](http://www.microscopy.org)

#### More Meetings and Courses

Check the complete calendar near the back of this magazine.

## Carmichael's Concise Review

# Corals May Be Able to Save Themselves

Stephen W. Carmichael

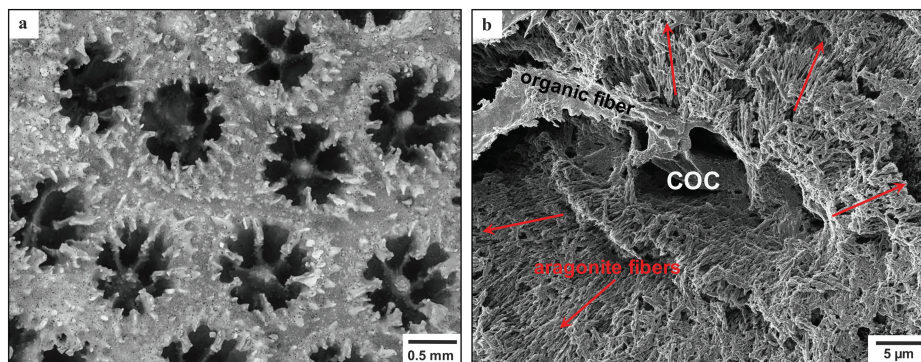
Mayo Clinic, Rochester, MN 55905

[carmichael.stephen@mayo.edu](mailto:carmichael.stephen@mayo.edu)

Many people are aware that corals are threatened by ocean warming and acidification, among other factors. A better understanding of the formation of coral skeletons could help predict the ability of corals to respond to these threats. It is known that stony coral skeletons are largely composed of aragonite, a crystalline polymorph of calcium carbonate ( $\text{CaCO}_3$ ). However, there is no clear consensus on how these aragonite skeletons are formed. The two prevailing hypotheses are that this is either a physiochemical-dominated process based on complex metabolic control of calcifying fluid chemistry or a biologically controlled process. In the latter the skeletal organic matrix (SOM) secreted by the animal plays the most important role. Recently, Stanislas Von Euw, Paul Falkowski, and colleagues combined high-tech imaging and local spectroscopy techniques to show that mineral deposition is biologically driven [1].

Von Euw et al. used the well-studied ubiquitous stony coral *Stylophora pistillata*, commonly known as hood coral or smooth cauliflower coral, as a model for investigating the coral biomineralization process. They applied a materials science approach that combined Raman imaging and spectroscopy, scanning helium ion microscopy (SHIM), and solid-state nuclear magnetic resonance (NMR) spectroscopy. This approach revealed the crystallization pathway of aragonite and provided unprecedented insights into the relation between the mineral phase and the SOM across different spatial scales.

Raman spectroscopy not only demonstrated the presence of organic material concentrated in centers of calcification (COC), but it also showed the presence of “immature” aragonite particles spatially closely related to the SOM in the COCs. To examine the role of the SOM concentrated in the COCs, Von Euw et al. applied SHIM to provide ultrahigh-resolution three-dimensional images with excellent depth of field, which can be applied to an intact piece of coral skeleton (Figure 1). The organic material was observed as fibers perpendicular to the plane in which the aragonite fibers grew. The “immature” aragonite



**Figure 1:** Coral skeleton surfaces. (a) Scanning electron microscope image showing the intact surface of a skeletal branch. Image width = 0.5 mm. (b) Scanning helium ion micrograph of a center of calcification surrounded by aragonite fibers obtained from the broken, unpolished, etched-surface of a skeletal branch. Image width = 50  $\mu\text{m}$ . Credits to Viacheslav Manichev and Stanislas Von Euw of Rutgers University.

# Sample Preparation of Nanocomposites and Nanomaterials by *Ultramicrotomy*

## a Powerful Alternative to FIB

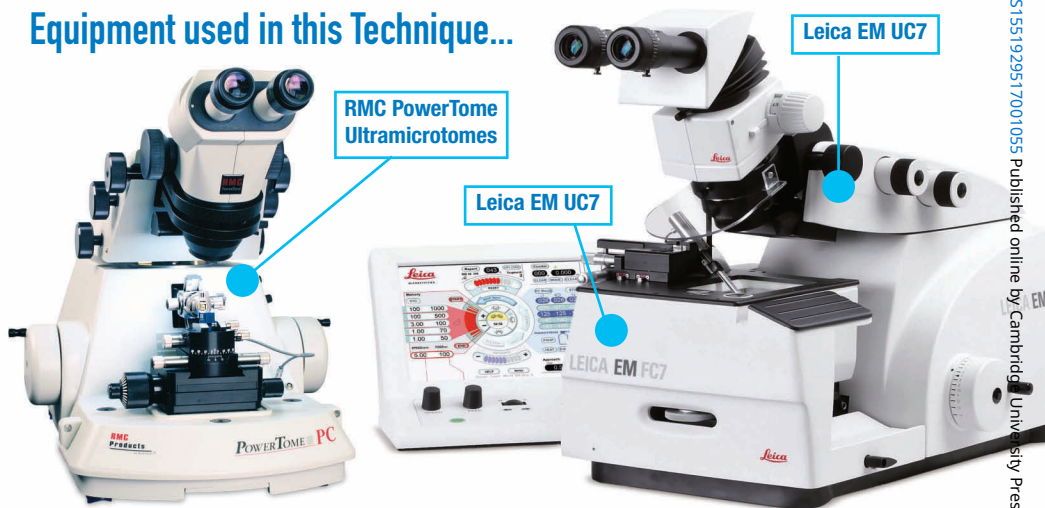
Join us at the **EMS Microscopy Academy** and learn the latest techniques to reveal internal structures of composites and polymers being investigated with transmission electron microscopy (TEM) and scanning transmission electron microscopy (STEM).

Sample preparation workflow will be illustrated using the Leica EM UC7 Ultramicrotome, its EM FC7 Cryochamber, and the RMC PowerTome Ultramicrotome. Differences between FIB (Focussed Ion Beam) and ultramicrotomy samples will also be covered.

### Who can benefit from this alternative?

- Composite and polymer research companies - especially from the automotive and aviation industries
- Materials scientists already working with ultramicrotomy
- FIB users preparing TEM lamellas

### Equipment used in this Technique...



#### DiATOME trimtool

Trimming of epoxy and acrylic embeddings, polymers and non-ferrous metals

#### DiATOME cryo

sectioning of cryo-protected specimens, frozen hydrated specimens and industrial samples such as polymers and rubber.

#### DiATOME ultra AFM

Surface sectioning for AFM investigation

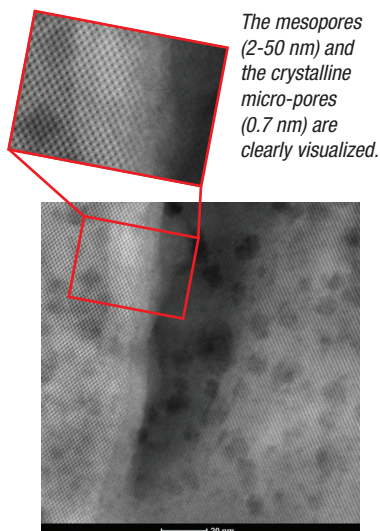
#### DiATOME ultra sonic

Rigid polymers such as PS, PMMA, ABS, HIPS, modified PP, etc.



### Applications...

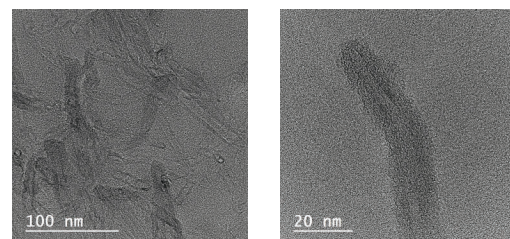
#### Zeolite USY30 Crystal morphology STEM analysis



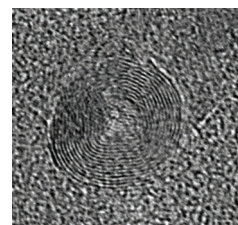
The mesopores (2-50 nm) and the crystalline micro-pores (0.7 nm) are clearly visualized.

[110] Tom Willhammar, Sara Bals, EMAT Antwerpen

#### Epoxy loaded with amino-functionalized CNTs TEM analysis



Good preservation of the interphase



Gravitational stroke!

Mert Kurttepel, Sara Bals, EMAT Antwerpen

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evidence by Raman spectroscopy was in the form of nanosized particles intercalated in the organic fiber surface.

These and other results indicated that mineral deposition in stony corals is initiated by the formation of a transient disordered precursor phase, which is probably in the form of amorphous calcium carbonate nanoparticles. The results of Von Euw et al. also revealed that these nanoparticles are deposited in microenvironments that are enriched in SOM secreted by the animal, specifically the COCs. Additional results obtained by solid state NMR further support the suggestion that the ability of corals to calcify is biologically controlled.

Von Euw et al. have shown that of the two prevailing mechanisms for formation of coral skeletons, the most likely is the biologically controlled process. This suggests that stony corals may be able to sustain calcification even in a more acidic environment than would be possible by physical chemistry alone. One can speculate that this biological process could undergo evolution over a period of decades or centuries to allow corals to survive in an even more hostile future.


#### References

- [1] Von Euw et al., *Science* 356 (2017) 933–8.
- [2] The author gratefully acknowledges Dr. Stanislas Von Euw for reviewing this article.

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## Bad for Vibrations



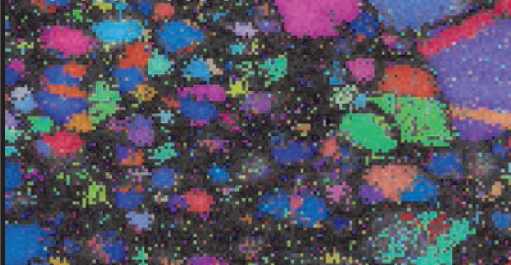
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## Great for Images

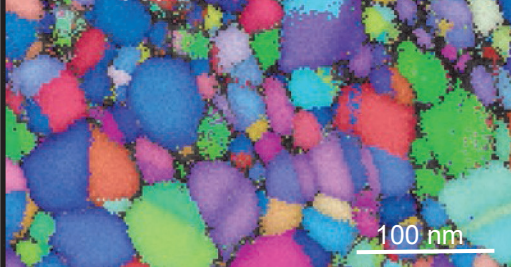
[www.minusk.com](http://www.minusk.com)

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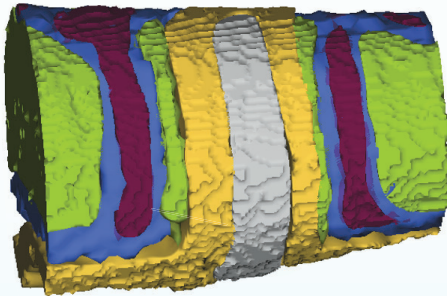
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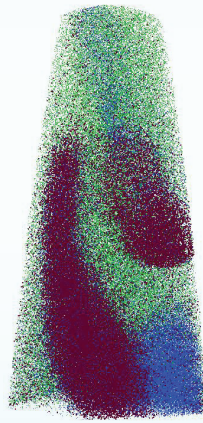
# Go Big – Think Small

Atom Probe Tomography (APT) is the only material analysis technique offering extensive capabilities for simultaneous 3D imaging and chemical composition measurements at the atomic scale. Leading academic institutions use APT for groundbreaking research, and world-class manufacturers rely on APT for process improvement and materials innovation.

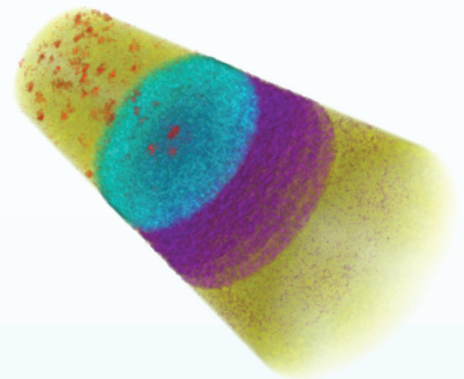
Atomic-level samples generated by APT reveal 3D chemical information not visible via other microscopy techniques.



3D volume showing the pure Si fin surrounded by the metal gate structure in a 14 nm microprocessor device



Boron segregation to a grain boundary in a Ni superalloy with carbide and boride precipitates



GaN LED device structure with Mg precipitation (red) and InGaN quantum well structure (purple)

CAMECA, the recognized world leader in atom probe development and manufacturing, offers two leading-edge APT instruments: the EIKOS™ and the LEAP® 5000.



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