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February 24, 2006

## Researchers Tackle Nanoelectronics RoadBlocks

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University at Buffalo (UB) engineers are working to solve two significant roadblocks impeding the creation of smaller, faster and more powerful electronic devices.

Working atom by atom, Cemal Basaran, Ph.D., and David Kofke, Ph.D., are taking on the problems of electromigration and thermomigration -- the tendency for atoms to behave erratically when charged by the very high density electrical currents required to power super-small and super-powerful electronic devices.

Basaran is director of the Electronics Packaging Lab in the UB School of Engineering and Applied Sciences and is professor in its Department of Civil, Structural and Environmental Engineering. A UB Distinguished Professor, Kofke is chair of the Department of Chemical and Biological Engineering in the School of Engineering and Applied Sciences.

High electrical current densities and high temperature gradients create voids within metal conductors, the researchers explain. This leads to breakdowns in circuitry and results in device failure. Moreover, as electronic devices and their circuits get smaller -- down to the nanoscale -- the damaging effects of electromigration and thermomigration increase.

With the support of a \$250,000 grant from the National Science Foundation, Basaran and Kofke are using computer simulations and laboratory experiments to devise ways to lessen or stop electromigration and thermomigration. Engineers from the Intel Corp. are collaborating with the UB researchers on the project.

"Once we learn to stop this self-destructive process in metals, any component in a computer chip can be made at the nanoscale," says Basaran. "But unless you solve this problem, you cannot have fast-performing nanoelectronic devices, and further miniaturization in electronics may not be possible."

The science of nanoelectronics is focused on creation of nanoscale circuits, wires and packaging of semiconductors. The goal of industry is to use these components to manufacture a new class of very small and very powerful electronic devices, such as wristwatch-sized supercomputers. One nanometer is about 1/100,000 of a human-hair diameter.

Working at the nanoscale level, the researchers intend to build semiconductor devices one atom at a time. According to Basaran, controlling placement of atoms in a material will give the researchers precise control of their properties, thus reigning in the erratic behavior that causes system breakdowns.

"When you design materials at the atomic scale you get properties you wouldn't get otherwise," Basaran says. "You get exact properties that you want instead of what nature dishes out for you. This means you can do things with a material that you couldn't imagine doing before with the same material."

The goal of the UB researchers is to design nanoscale chips, circuits and solder joints that can withstand very high current densities and very high temperature gradients.

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[/networks/index.rss2\)](http://www.hpcwire.com/topic/networks/index.rss2)

[Processors \(<http://www.hpcwire.com>/topic](http://www.hpcwire.com/topic/processors/index.rss2)

[/processors/index.rss2\)](http://www.hpcwire.com/topic/processors/index.rss2)

[Storage \(<http://www.hpcwire.com>/topic](http://www.hpcwire.com/topic/storage/index.rss2)

[/storage/index.rss2\)](http://www.hpcwire.com/topic/storage/index.rss2)

[Systems \(<http://www.hpcwire.com>/topic](http://www.hpcwire.com/topic/systems/index.rss2)

[/systems/index.rss2\)](http://www.hpcwire.com/topic/systems/index.rss2)

[Visualization \(<http://www.hpcwire.com>](http://www.hpcwire.com/topic/visualization/index.rss2)

[/topic/visualization/index.rss2\)](http://www.hpcwire.com/topic/visualization/index.rss2)

### Feeds by Content Type

[Top Headlines \(<http://www.hpcwire.com>](http://www.hpcwire.com/news/index.rss2)

[/news/index.rss2\)](http://www.hpcwire.com/news/index.rss2)

[Features \(<http://www.hpcwire.com>](http://www.hpcwire.com/features/index.rss2)

[/features/index.rss2\)](http://www.hpcwire.com/features/index.rss2)

[Blogs \(<http://www.hpcwire.com>/blogs](http://www.hpcwire.com/blogs/index.rss2)

[/index.rss2\)](http://www.hpcwire.com/blogs/index.rss2)

[Whitepapers \(<http://www.hpcwire.com>](http://www.hpcwire.com/whitepapers/index.rss2)

[/whitepapers/index.rss2\)](http://www.hpcwire.com/whitepapers/index.rss2)

[Multimedia \(<http://www.hpcwire.com>](http://www.hpcwire.com/multimedia/index.rss2)

[/multimedia/index.rss2\)](http://www.hpcwire.com/multimedia/index.rss2)

[Off the Wire \(<http://www.hpcwire.com>](http://www.hpcwire.com/offthewire/index.rss2)

[/offthewire/index.rss2\)](http://www.hpcwire.com/offthewire/index.rss2)

[HPCwire Soundbite](http://www.hpcwire.com/HPCwireSoundbite.rss)

[\(<http://www.hpcwire.com>](http://www.hpcwire.com/HPCwireSoundbite.rss)

[/HPCwireSoundbite.rss\)](http://www.hpcwire.com/HPCwireSoundbite.rss)

### Feeds by Industry

[Academia & Research](http://www.hpcwire.com/industry/academia/index.rss2)

[\(<http://www.hpcwire.com>/industry](http://www.hpcwire.com/industry/academia/index.rss2)

[/academia/index.rss2\)](http://www.hpcwire.com/industry/academia/index.rss2)

[Financial Services](http://www.hpcwire.com/industry/financialservices/index.rss2)

[\(<http://www.hpcwire.com>/industry](http://www.hpcwire.com/industry/financialservices/index.rss2)

[/financialservices/index.rss2\)](http://www.hpcwire.com/industry/financialservices/index.rss2)

[Government \(<http://www.hpcwire.com>](http://www.hpcwire.com)

[/industry/government/index.rss2\)](#)

**Life Sciences** (<http://www.hpcwire.com>

[/industry/lifesciences/index.rss2\)](#)

**Manufacturing** (<http://www.hpcwire.com>

[/industry/manufacturing/index.rss2\)](#)

**Oil & Gas** (<http://www.hpcwire.com>

[/industry/oilandgas/index.rss2\)](#)

**Retail** (<http://www.hpcwire.com/industry>

[/retail/index.rss2\)](#)

(<http://cas.clickability.com/cac?a=262507&n=140247&d=315267&c=8500516>)

Off the Wire ([http://www.hpcwire.com/templates/off\\_the\\_wire.html](http://www.hpcwire.com/templates/off_the_wire.html)) | Most Read ([http://www.hpcwire.com/templates/most\\_read.html](http://www.hpcwire.com/templates/most_read.html)) | Blogs ([http://www.hpcwire.com/templates/mp\\_blogs.html](http://www.hpcwire.com/templates/mp_blogs.html))

Available every Friday Afternoon @  
HPCwire.com

**May 29, 2009**

**IBM, Syracuse University, New York State to Build Energy-Efficient Datacenter** (<http://www.hpcwire.com/offthewire/IBM-Syracuse-University-New-York-State-to-Build-Energy-Efficient-Datacenter-16468807.html>)

## Top Headlines

**Q&A with HPC Virtualization Software Maker ScaleMP** (<http://www.hpcwire.com/news/QA-with-HPC-Virtualization-Software-Maker-ScaleMP.html>)

**May 29 | insideHPC** | ScaleMP CEO Shai Fultheim talks about his company, its technologies, and why this particular moment of change is turning into such a boon for them. [Read more...](#)





**Apr 28** | | Engineers, scientists, and other domain experts depend on the productivity enabled by very high-level language (VHLL) tools like MATLAB® and Python. However, as datasets grow larger and programs get more sophisticated, ordinary desktop computers can no longer keep up. The paper explores how to run VHLL programs on high-performance platforms without low-level reprogramming. Work with large datasets and complex algorithms without sacrificing ease of use or reducing productivity.

**[Building High Performance Computing in a Green and Modular Solution Building Block](http://www.hpcwire.com/jobbank/?url=jobdetails%2Ecfm%3Fjid%3D366)**  
[\(/r?19=950&32=4982&7=315267&40=http%3A%2F%2Fwww.appro.com%2Fwhitepaper%2FHPC\\_in\\_a\\_Green%3A%2F%2Fwww.appro.com%2Fwhitepaper%2FHPC\\_in\\_a\\_Green%3A%2F18=0.19814161274623332\)](http://www.hpcwire.com/jobbank/?url=jobdetails%2Ecfm%3Fjid%3D366)

**Apr 14** | | Many HPC IT departments are feeling the rising pressure to deliver more capacity computing and performance while trying to reduce the total cost of ownership. This white paper discusses how an environmentally-friendly and open-standards HPC building block based computing system using flexible interconnect options helps address capacity computing needs.

**[View the White Paper Library](http://www.hpcwire.com/whitepapers)**  
 [\(http://www.hpcwire.com/whitepapers\)](http://www.hpcwire.com/whitepapers)

## Multimedia

**[Webcast: Dell Expands HPC Access and Adoption with Intel Cluster Ready Program](http://www.hpcwire.com/multimedia/Dell-Expands-HPC-Access-and-Adoption-with-Intel-Cluster-Ready-Program.html)**  
 [\(http://www.hpcwire.com/multimedia/Dell-Expands-HPC-Access-and-Adoption-with-Intel-Cluster-Ready-Program.html\)](http://www.hpcwire.com/multimedia/Dell-Expands-HPC-Access-and-Adoption-with-Intel-Cluster-Ready-Program.html)

Source: Addison Snell, GM/VP, Tabor Research; sponsored by Dell

Many organizations that could benefit from the use of HPC clusters find that it is complicated to get the systems up and running because of limited IT resources or the complexities of the clusters themselves. Learn how the Intel Cluster Ready program, for which Dell was an original partner, seeks to address this challenge for entry level and mid-range

## **[Associate Laboratory Director--Computing & Computational Sciences](http://www.hpcwire.com/jobbank/?url=jobdetails%2Ecfm%3Fjid%3D366)**

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 Oak Ridge National Laboratory

## **[Center Director, Deep Computing Research Center](http://www.hpcwire.com/jobbank/?url=jobdetails%2Ecfm%3Fjid%3D350)**

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 King Abdullah University of Science and Technology

## **[Scientific Software Development in Computational Biochemistry](http://www.hpcwire.com/jobbank/?url=jobdetails%2Ecfm%3Fjid%3D371)**

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 D. E. Shaw Research

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## Featured Events

[\(http://www.the-modeling-agency.com/hpc\)](http://www.the-modeling-agency.com/hpc)

June 16, 2009

**[Data Mining: Failure to Launch](http://www.the-modeling-agency.com/hpc)**  [\(http://www.the-modeling-agency.com/hpc\)](http://www.the-modeling-agency.com/hpc)

WWW



HPC users.


**[Video White Paper: Architecting a Better Network Storage Solution](http://www.accelacomm.com/jlp/bluearc1/0/80548915/)**  
**[\(http://www.accelacomm.com/jlp/bluearc1/0/80548915/\)](http://www.accelacomm.com/jlp/bluearc1/0/80548915/)**

BlueArc's Titan architecture represents an evolutionary step in file servers by creating a hardware-based file system that can scale bandwidth, IOPS, and overall data capacity well beyond conventional software-based devices. With its ability to virtualize a massive storage pool of up to four usable petabytes of tiered storage, Titan can scale with growing data requirements, offering a competitive advantage for businesses, researchers, or other enterprises seeking to better manage data growth while still ensuring optimal performance.

**[Webcast: HPC Development Solutions: Sun Studio & Sun HPC ClusterTools](http://www.hpcwire.com/multimedia/HPC-Development-Solutions-Sun-Studio-and-Sun-HPC-ClusterTools.html)**  
**[\(http://www.hpcwire.com/multimedia/HPC-Development-Solutions-Sun-Studio-and-Sun-HPC-ClusterTools.html\)](http://www.hpcwire.com/multimedia/HPC-Development-Solutions-Sun-Studio-and-Sun-HPC-ClusterTools.html)**

Sun Studio Compilers and Tools and Sun HPC ClusterTools allow you to create high performance parallel applications for OpenSolaris, Solaris and Linux. Sun Studio Express 11/08 includes MPI performance analysis capabilities and full OpenMP 3.0 compiler support. Learn about all this and the latest in Sun HPC ClusterTools 8.1.

**[More Multimedia \(http://www.hpcwire.com/multimedia\)](http://www.hpcwire.com/multimedia)**

**[HPCS 2009](http://www.hpcs2009.org)**  **[June 17-19, 2009](http://www.hpcs2009.org)**  
**[High Performance Computing Symposium 2009](http://www.hpcs2009.org)**

**[\(http://www.hpcs2009.org/\)](http://www.hpcs2009.org/)**

Kingston , Ontario

Canada



**[\(http://www.teragrid.org/tg09/\)](http://www.teragrid.org/tg09/)**

**[June 23-26, 2009](http://www.teragrid.org/tg09/)**

**[International Supercomputing Conference ISC'09](http://www.teragrid.org/tg09/)**

**[Hamburg Germany](http://www.isc09.org)**

Hamburg Germany

**[COURSES IN PREDICTIVE ANALYTICS](http://www.the-modeling-agency.com/hpc/data-mining.html)**  
*Learn How Experts Mine Data*

**[Learn How Experts Mine Data](http://www.the-modeling-agency.com/hpc/data-mining.html)**

**[agency.com/hpc/data-mining.html](http://www.the-modeling-agency.com/hpc/data-mining.html)**

**[August 24-28, 2009](http://www.the-modeling-agency.com/hpc/data-mining.html)**

**[Data Mining: Levels I, II, & III](http://www.the-modeling-agency.com/hpc/data-mining.html)**

**[\(http://www.the-modeling-agency.com/training/series.html\)](http://www.the-modeling-agency.com/hpc/data-mining.html)**

Denver , CO

USA

**[WORLD COMP 2009](http://www.world-academy-of-science.org/worldcomp09/ws)**  
 Las Vegas, Nevada, USA July 13-16

**[http://www.world-academy-](http://www.world-academy-of-science.org/worldcomp09/ws)**

**[of-science.org/worldcomp09/ws\)](http://www.world-academy-of-science.org/worldcomp09/ws)**

**[July 13-16, 2009](http://www.world-academy-of-science.org/worldcomp09/ws)**

**[WORLD COMP'09 - The 2009](http://www.world-academy-of-science.org/worldcomp09/ws)**

**[World Congress in Computer Science, Computer Engineering, and Applied](http://www.world-academy-of-science.org/worldcomp09/ws)**

**[Computing \(http://www.world-academy-of-science.org/worldcomp09/ws\)](http://www.world-academy-of-science.org/worldcomp09/ws)**

Las Vegas , NV

USA

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