designlines AUTOMOTIVE

News & Analysis

15 Hot Tech Stories for 2016

EDN, EE Times Staff

12/1/2015 11:46 AM EST

1 Comment

In a way, 2015 was a tipping point, a year that saw its own innovations but in many ways brought electronics across the bridge to promises we've heard for some time.

Promises of affordable and efficient LED lighting, smart and useful wearables, cars with driver assistance, advanced power systems to meet the needs of growing data center and mobile data traffic, and much more.

As we head toward 2016, we look forward to more innovation and advances, to promises being met and more promises ahead. Here, EDN and EE Times editors explore some of the hot technologies in 2016 that will shape next year's technology trends and beyond.

Each article offers the opportunity for you, members of the engineering community, to share your own thoughts about the technologies and devices presented, as well as on other hot technologies you see on the horizon.

Click through the below hot technologies articles and be sure to share your thoughts as we look ahead to 2016.

Driven by IEEE standards, Ethernet hits the road in 2016

A new trend emerging in the automotive market in 2016 is the migration of Ethernet, a tried-and-true computer network technology, into connected cars. The proliferation of advanced driver assistance system (ADAS) features in many vehicles is also expected to expand Ethernet use.

Embedded security taking root

Embedded systems that add connectivity face many challenges, of which the need for security is both vital and misunderstood. But vendors and developers have been getting the message and solutions are appearing in greater numbers, from software libraries to MCUs with a secure root of trust.

Energy harvesting for high power

It's taking a while to sow the seeds for energy harvesting. While much industry focus may be on powering the Internet of Things, the future may be bigger for energy harvesting.

Environmental compliance 2016: Safe world, strong business

In the electronics industry, the topic of environmental compliance

Most Recent Comments

BobH770 The debug logs say that the wizard turned him into a pigeon. The eagle will be along shortly and we can all go to lunch.

6/30/2016
11:44:43 AM

Navigate to Related Links

Nvidia Builds Connections to AI Researchers
Columbus, Ohio Gets Smart
Thinking Beyond Stop-Start
Daimler Gets Electrified
Driverless Car on Same Road as 3D TV?

has taken its place in the sweet spot between legally mandated and good for business. Increasingly, OEMs are tackling topics that range from climate change to water safety to waste management.

Galvanic skin response stimulates wearable electronics
A fast growing market in the health and fitness arena is the wearable device, which monitors with GSR to accurately predict cardiovascular dynamics.

High stakes in broadband satellites race
Building a satellite network and associated ground-based facilities and user terminals to provide Internet access to even the remotest and poorest parts of the world will be a huge technical, regulatory, and business challenge. Just as well then that some of the richest and most entrepreneurial mavericks are promoting competing projects, with some giant electronics groups seeking to enter the fray.

IoT networks heat up
Low-power wide area networks for the Internet of Things have been attracting new entrants and investors at a heady pace with unannounced offerings still in the pipeline for 2016 trying to enable new IoT apps by undercutting costs and battery life for cellular and WiFi.

LED lighting: More intelligent, more beautiful, more affordable
The LED industry's products will become more efficient, reliable, and, one can hope, interoperable in the near future. But underlying all these advances will be the relentless pressure to deliver LEDs at lower price points.

PAM4: A new measurement science
PAM4 modulation adds a complexity to serial data communications. Measuring its characteristics is a learning experience in progress.

Sensor-rich ADAS speeds up
Advanced Driver Assistance Systems and autonomous vehicles continue forward as sensors begin to move into the role of not just capturing data effectively, but also analyzing it and communicating the results to the driver and the vehicle.

Software-defined power brings to bear critical need in modern power systems
Growing data center and mobile data traffic is pushing data centers and telecom central offices to their limits of power efficiency and heat excess. Software-defined power has the potential to alleviate this challenge.

The year of 3D memory
3D ICs have been around for a while, but now they're getting real.

Voice-activated interface becomes pervasive and persistent
Evolutionary algorithm improvements, ongoing progress in optimizing processor performance, power consumption and cost-effectiveness, and pervasive, high-bandwidth and "cloud" server resources are among the drivers of the speech-interface explosion.

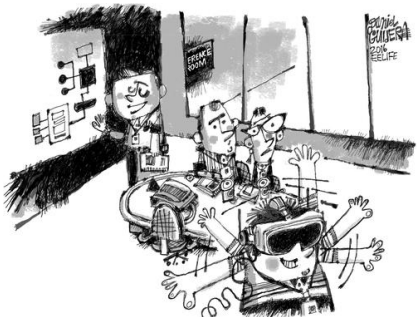
2D semiconductors take aim at optical communications
Developments in the lab offer glimpses of a technology that could change the future of high-performance optical links.

2016: The year of the nanotube transistor?
Carbon nanotubes have once again become popular as the replacement for silicon, which is reaching the end of the International Technology Roadmap for Semiconductors. After 15 years, researchers are returning to nanotubes with a vengeance. Last year IBM claimed "nanotube transistors by 2020 or bust" and has already demonstrated a working nanotube transistor with a 9-nanometer channel and a clear path down to the 1.8-nanometer node.

Also see:

- Hot technologies: Looking ahead to 2015
- Hot technologies: Looking ahead to 2014
- Hot technologies: Looking ahead to 2013

Hot Tech list originally published on EDN.com.



designlines SoC

News & Analysis

2016: Year of the Nanotube Transistor?

R. Colin Johnson

12/1/2015 06:01 AM EST

Post a comment

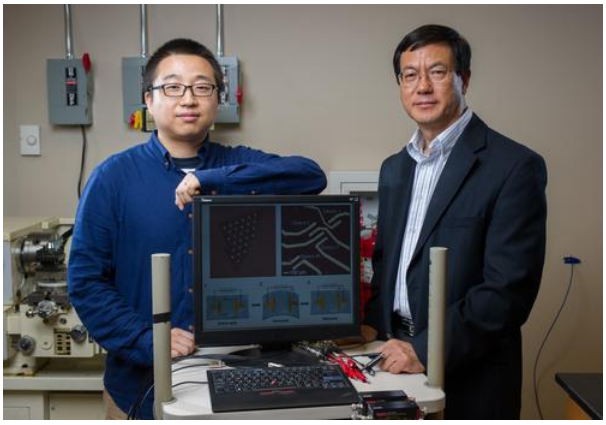
NO RATINGS
LOGIN TO RATE

This article is part of EDN and EE Times' Hot Technologies: Looking ahead to 2016 feature, where our editors examine some of the hot trends and technologies in 2015 that promise to shape technology news in 2016 and beyond.

Nanotube research has been ongoing since 1991, when they were first discovered by researcher Sumio Iijima at NEC (Japan). He described nanotubes as the fourth form of carbon, after graphite, diamonds and fullerenes (Buckyballs). Consistently measuring about 1.2 nanometers in diameter (for the single walled variety) they are essentially atomically thin layers of graphene rolled into tubes.

Nanotubes were almost immediately identified as a possible replacement for the channel in silicon transistors, because their electron mobility is in excess of 100,000-cm2/volt-second at room temperature—over 70 times faster than the 1,400-cm2/V-s mobility of standard silicon chips.

Different methods were tried to place pre-made nanotubes across the source and drain of a silicon transistors, and secondly to use a seed placed atop the source and drain and try to grow them in place. Such attempts have been made by labs around the world repeatedly from 2002 to 2015 but none have been as successful as placing pre-made nanotubes.



Postdoctoral fellow Wenzhuo Wu (left) and Professor Zhong Lin Wang (right) at Georgia Tech propose molybdenum disulfide as the wonder materials to

Most Recent Comments

anon7632755 Self-encrypting drives make automatic incremental backup systems, like Apple Time Machine, unusable. But, at least in the Mac OS X world, there is a compromise between leaving...

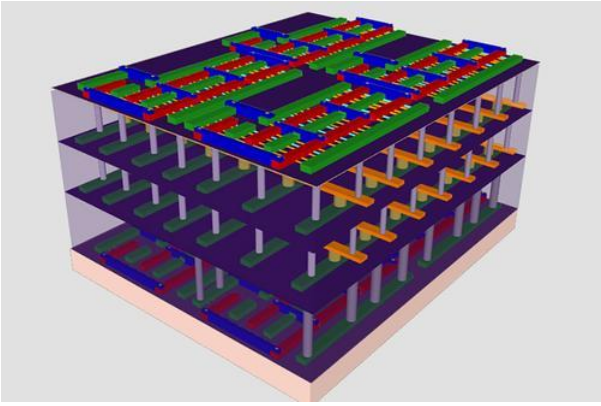
6/30/2016 1:21:15 PM

Navigate to Related Links

- Not-So Quiet Race in Wide Band Gap Semiconductor
- AMD Buys PC Gaming Software Firm
- Intel Renews Deal with Irish Research
- System Scaling Key to Semiconductor Progress
- Patent Infringement Cases Just Got Easier

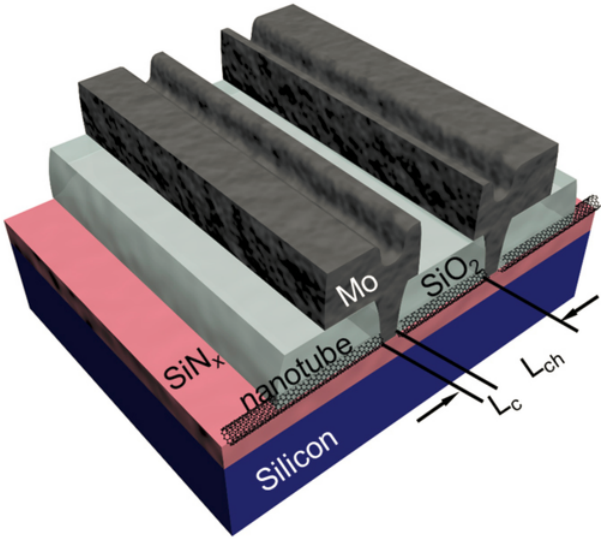
replace silicon because it is extremely light, bendable, stretchable and piezoelectric. (SOURCE: Rob Felt, Georgia Tech)

Nanotubes are easy to make by mechanical methods, but unfortunately some are metallic instead of semiconducting—due to their chirality—making it essential to find ways to eliminate the metallic kind which would just short-out a transistor. Two methods have been successful developed, one sorting them ahead of time and the second burning out the metallic ones after placement with a high-voltage pulse, like opening a fuse.



3-D chip from Stanford connects four layers with standard vias, with the bottom being standard CMOS, the top being carbon-nanotube logic transistors, and the middle two layers of resistive random access memory (RRAM). (SOURCE: Stanford University, Mitra/Wong Lab)

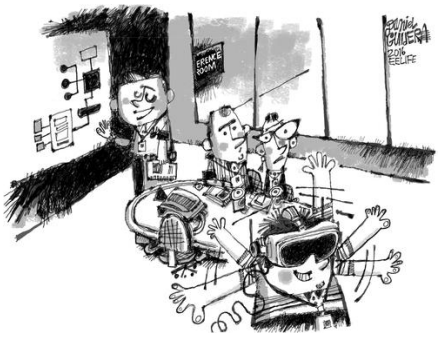
Once that problem was solved, the last problem became how to put them where you want them—as channels—on a silicon substrate. At first they were merely placed randomly, with little success, but in 2015 IBM reported a successful auto-alligment method for placing them across the source and drain, using as many of them as is necessary in parallel to carry the current needed.



A diagram showing IBM's fabricated nanotube transistor with an end-bonded contact and a contact length below 10-nanometer. (SOURCE: IBM Research)

Cartoon **Contest**

June 2016 Cartoon Caption Contest " Virtual Un-Reality"



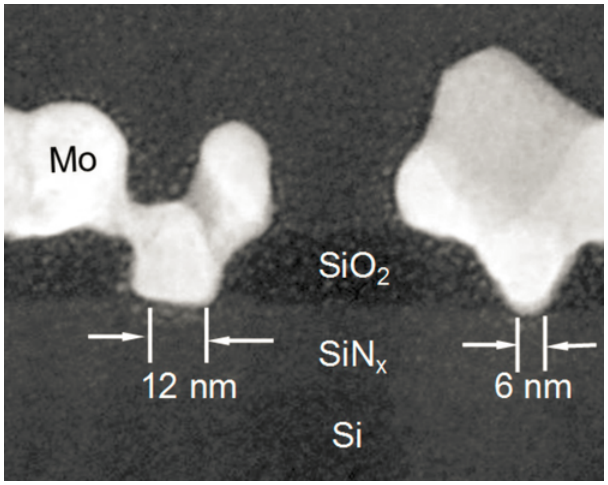
"Your caption here!"

151 comments

ALL CARTOONS

Most Commented **Most Popular**

- 64 Where Are All the TEM-Based Bar Jokes?
- 62 Precision Control of a Radio-Controlled ...
- 43 A (Good) Picture is Worth 1,000 Words
- 40 How Do You Know When an Engineer is Cooked?
- 38 Electronics Flea Market, 2016 Edition
- 30 Forlorn with Friggatriskaidekaphobia
- 29 Hail & Farewell Summer Solstice 2016
- 28 Friday Quiz: Max the Magnificent
- 27 Farberisms Rule, Spoonerisms Drool
- 27 Bike2: A Novel Powertrain for Electric Bikes



Transmission electron microscope (TEM) Cross-sectional image showing the fabricated nanotube transistor with an end-bonded contact. (Source: IBM Research)

The graphene researchers have not given up—in fact Texas Instruments is now capable of growing wafer scale graphene and the Chinese have taken the lead in developing both graphene and nanotubes according to Lux Research.

"Aggregate current capacity of Chinese carbon nanotube suppliers can meet forecasted global demand until 2015," according to Lux Research Analyst Zhun Ma. But in 2016 demand will outgrow China's capacity to supply, providing yet another reason that this is the year of the nanotube transistor.

Also watching:

- FinFETs with III-V Channels: While nanotubes provide the fastest channel material available today, III-V materials like gallium arsenide (GaAs) and indium gallium arsenide (InGaAs) are all being explored by IBM, Intel, Imec and Samsung as transistor channels on silicon substrates. In fact, just this year Imec and IBM both reported similar methods of successfully doing so. IBM's called confined epitaxial overgrowth—or CELO—merely grows a thin oxide on a silicon wafer, then etches trenches down to the silicon where ever it wants a transistor channel. It then grows the III-V material from the trench—acting as a seed—without the lattice mismatch problems that would plague growing III-V on silicon.
- 2-D Black Phosphorus Beats Carbon: Dozen of researchers worldwide are experimenting with black phosphorus as an alternative to nanotubes and graphene for the next generation of semiconductors. Black phosphorus has the advantage of having a bandgap and works well alongside silicon photonics devices, which are also skyrocketing in popularity.
- 3-Molybdenum disulphide MoS2 is also a contender for the next generation of semiconductors, due to its novel stacking properties. For instance, a single layer of it is a normal semiconductor, but add a second layer and it become piezoelectric (likewise even numbers of layers is piezoelectric and any odd number of layers is not). The team of Professor Zhong Lin Wang and postdoctoral fellow Wenzhuo Wu are building a new type of transistor with it at Georgia Tech.

Also see:

- IBM Pledges Nanotube Transistor by 2020 or Bust
- IBM Nanotubes May Redefine Future of Moore's Law
- Organics To Extend Moore's Law
- TI growing large-area graphene
- Nanotubes sorted, aligned to reduce friction

— R. Colin Johnson, Advanced Technology Editor, EE Times

Read more of EDN and EE Times' Hot Technologies: Looking

ahead to 2016:

- Driven by IEEE standards, Ethernet hits the road in 2016
- Embedded security taking root
- Energy harvesting for high power
- Environmental compliance 2016: Safe world, strong business
- Galvanic skin response stimulates wearable electronics
- High stakes in broadband satellites race
- IoT networks heat up
- LED lighting: More intelligent, more beautiful, more affordable
- PAM4: A new measurement science
- Sensor-rich ADAS speeds up
- Software-defined power brings to bear critical need in modern power systems
- Voice-activated interface becomes pervasive and persistent
- 2D semiconductors take aim at optical communications
- 2016: The year of the nanotube transistor?

EMAIL THIS PRINT COMMENT

More Related Links

Not-So Quiet Race in Wide Band Gap Semiconductor

AMD Buys PC Gaming Software Firm

Intel Renews Deal with Irish Research

System Scaling Key to Semiconductor Progress

Patent Infringement Cases Just Got Easier

Comments

VIEW COMMENTS: **NEWEST FIRST** | OLDEST FIRST | THREADED VIEW

Be the first to post a comment regarding this story.

- **Sign up for EE Times newsletter**