DANIEL BURRUS'
TECHNO TRENDS
THE BIG IDEAS THAT ARE CHANGING EVERYTHING

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3D Printing Breakthrough

By Daniel Burrus, CEO of Burrus Research

We're about to start seeing the most fascinating proof of concept projects hit the consumer markets. The business sectors that will be most dramatically affected will be healthcare, manufacturing, construction, transportation, aerospace, and life sciences. But 3D printing is going to be hugely disruptive to every industry — including, most especially, yours.

Enter Multi-Materials Printing

The most promising and newest 3D printing technology enables the use of dozens of different materials simultaneously in one print run. Materials range from biological filament and living tissue to chocolate, rubber, metals, plastics, clay, and wood fiber.

We have reached the point where 3D-printed electronics can be successfully integrated with multiple materials and complex shapes. In short, we are rapidly entering a world in which many of the things, which you could previously only imagine, can be created — right in front of you. Don't believe me?

Last year scientists at Princeton University 3D-printed an ear out of living tissue, and embedded it with an antenna for a cochlear implant. This year they used the university's $20,000 LED 3D printer to create quantum dot LEDs which they then integrated with a contact lens. The result is a lens that can project rays of light.

The possibilities are endless. From transparent to opaque, rigid to flexible – you can mix and match materials in a single build to meet highly complex engineering or medical device needs, or to make realistic prototypes to accelerate testing and time to market.

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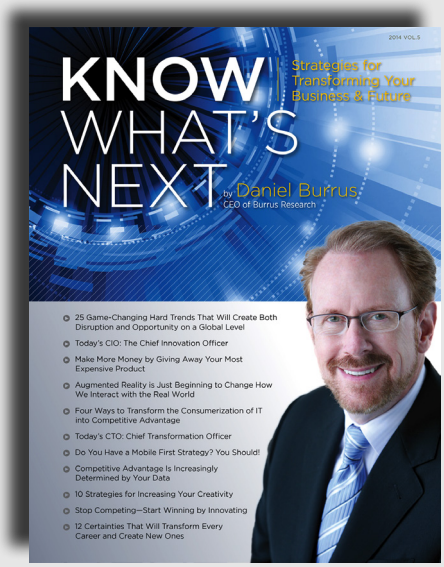
Know What's Next Magazine



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TECHNOLOGY NEWS HIGHLIGHTS

Blue Energy

Researchers in the Netherlands recently opened a facility to test the commercial viability of a largely untapped renewable energy resource. The facility will utilize the principle of reverse electrodialysis (RED) to take advantage of the natural difference in salt concentration that occurs wherever fresh water and salt water mix.

The technology employs two ion selective membranes – one for positively charged sodium ions and one for negatively charged calcium ions. As the ions are separated, they produce a battery. By placing thousands of these membranes between two electrodes, significant amounts of energy can be produced.

It has been estimated that one cubic meter per second of fresh water and sea water will produce 1 MW of power per year. That translates into a worldwide potential of 1.4 to 2.6 terrawatts of electricity that could be generated from rivers flowing into the sea. The same principles could also be applied to saline waste streams from industrial facilities.

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Rewriteable "Paper"

Somehow the dawn of the computer era fell woefully short of the promise for a "paperless society." In fact, by some estimates, ninety percent of the information shared day-to-day in businesses is still printed on paper, the bulk of which is discarded after a single use.

Sure...paper can be recycled, but in addition to the expense of the process alone, a lot of time and effort goes into protecting the information on that paper, before it even leaves a facility. Wouldn't it be nice to be able to recycle and reuse printed materials yourself? Well, that's the basic idea behind a new rewriteable medium being developed with some help from the U.S. Department of Energy.

A glass or plastic substrate is coated with a commercial redox (color-switching) dye (either blue, red or green) to form an imaging layer. Titania nanocrystals are added as catalysts and hydroxyethyl cellulose is used as a thickening agent. When a photomask is placed over the film, exposure to ultraviolet (UV) light bleaches the dye, except where the mask prevents it. The resulting image will be retained for about three days under normal ambient conditions – long enough to be practical for a variety of printed materials, such as newspapers – and the current films can be re-written up to twenty times without loss of contrast or resolution. Heating the material to 115 degrees Centigrade re-oxidizes the dye to its original color.

To expand the potential applications, researchers are currently exploring ways to increase the image life and number of print-erase cycles, as well as paper and multi-color options.

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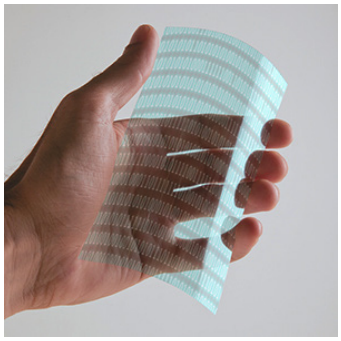
Graphene Armor



Who would have thought that the thinnest material known to mankind could have the strength to stop a bullet? Well, that's exactly what researchers, working with NASA and the military, are experimenting with.

Graphene – sheets of carbon just one atom thick – has some pretty amazing properties. One hundred and fifty times stronger than steel and two hundred and fifty times more conductive than silicon, it's also pliable enough to be stretched to 120 percent of its length. But this latest research demonstrated something that hadn't been tested before – namely, graphene's ability to absorb an impact.

Impact resistance is all about distributing stress over a large area. In order to test this, microscopic "bullets" were fired at graphene sheets at a speed of three kilometers per second (that's faster than an AK47 fires bullets). High speed cameras were used to capture the impacts on varying thickness of graphene to observe how the energy was absorbed. The tests indicate that graphene distributed the impact faster than any known material and was ten times better than the same weight of steel at taking a hit. Future applications will likely include lightweight, bullet-proof fabrics for law enforcement and military personnel, as well as micro-meteor shielding for spacecraft.

For information: Edwin Thomas, Rice University, Department of Materials Science and Nanoengineering, 6100 Main, MS-325, Houston, TX 77005; phone: 713-348-3698; email: ***elt@rice.edu*** *or* ***msne@rice.edu****; Web site:* ***www.msne.rice.edu/nedthomas***

High-Energy Battery

An experimental lithium-ion battery could double the range of electric cars without increasing cost. Since batteries are the single highest ticket item in today's electric vehicles, anything that can be done to cut cost or improve range can have a huge impact. And since they take up between 20 and 30 percent of the vehicle weight, energy content per system weight and volume is also an important consideration going forward.

The new, flat battery is solid-state, however, the manufacturer has overcome some of the biggest issues that others have encountered with non-liquid electrolytes. Like other solid electrolyte batteries, it utilizes pure lithium to improve conductivity. But unlike existing batteries, which incorporate other materials like graphite in order to prevent metal filaments from forming short circuits, the new technology eliminates the extra material to improve energy storage capacity. To prevent filaments from forming it contains two distinct polymer layers – one soft layer that conducts ions more effectively and one hard layer that forms a physical barrier between the electrodes.

Most importantly, the battery can be manufactured on conventional equipment, which will help keep costs down. Further testing is needed to determine how many charge/discharge cycles may be expected from the new design. Evaluation samples are expected to become available within the next year.

For information: Hal Zarem, Seeo, 3906 Trust Way, Hayward, CA 94545; phone: 510-782-7336; fax: 510-782-7337; Web site: ***seeo.com***

Spinal Cord Regenerator

A new drug is currently being tested on animals that may someday help reverse paralysis in people with spinal cord injury. But the discovery didn't occur exactly the way researchers were expecting.

It started 30 years ago with the discovery that a substance called a proteoglycan essentially functioned to "glue" severed nerves to scar tissue, effectively acting as a barrier to prevent nerves from growing where they weren't supposed to. It took ten more years of research to convince the rest of the scientific community, but the real breakthrough occurred when it was discovered the full extent to which proteoglycans play a part in paralysis.

So the goal became to develop a drug that could release the trapped fibers, enabling them to regenerate. After getting it to work in a Petri dish, it was tested on rats suffering from spinal injuries that left them with limb paralysis and lack of bladder control. Seven weeks of injections produced no results, but two to three weeks later, they started to show improvement. Eventually all of the rats regained some control of their bladder and one-third were able to walk again. But the function was not restored as a result of reconnecting nerves. Instead, the nerves were sprouting all over the place which flooded the spinal column with serotonin. It was this increased supply

of serotonin that amplified the signal from just a few intact nerves.

This represents an important step forward in paralysis research, especially since the drug itself can be administered as an injection under the skin. Other treatments, like stem cells, carry greater risk due to their invasive nature.

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Touchscreen Times Two

The new Sprout is one of the most interactive PCs yet, immersing the user in what HP has dubbed "blended reality." A 23-inch touchscreen display is coupled with a 20-inch touch-enabled mat that can act as a browser, scanner, desktop or standard keyboard. The "illuminator," which hangs like an awning over the entire unit, contains a desk lamp, a DLP projector, and a 14.6 megapixel high resolution camera to capture both 2D and 3D objects.

Sprout utilizes the latest Intel i7 processor, can be configured for up to 16GB of memory and has a full terabyte of storage. But its power is also combined with simplicity by using an app-driven user interface that can be as easy and straightforward or as complex as the user chooses.

It's all in line with blending the digital world with the physical world; humanizing technology; making it more tangible; and creating seamless, intuitive inputs and outputs. And it's all available for about $1900.

For information: ***https://sprout.hp.com***

3D Printed Car

The world's first (full-size) 3D printed car recently debuted at the 2014 SEMA Show in Las Vegas. Known as Strati, it will soon be available for download under a Creative Commons license. Would-be designers can also contribute improvements and modifications to the knowledge base.

The printing process uses fusion deposit modeling (FDM) similar to desktop 3D printers, but instead of a plastic filament extruder, it uses a pellet feed, which is more cost-effective and versatile. The parts are constructed by slicing a shape into layers and depositing a combination of about 80 percent ABS and 20 percent carbon reinforcing fiber slice by slice. There are about 212 layers in the chassis and it takes about 44 hours to print a complete set of body parts.

The power train, suspension and steering components are taken from a Renault Twizzy hybrid. On a full charge, the Strati has a range of about 62 miles and a top speed of 50 miles per hour. Wheels, lights and seats are the only other parts that are not 3D printed.

The company's sustainable and flexible factory model calls for 100 microfactories to be built over the next ten years, which will provide the services to fabricate and support the Strati and future models.

For information: Local Motors Headquarters, 1576B S. Nelson Drive, Chandler, AZ 85226; phone: 888-256-2028; Web site: ***https://localmotors.com***
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Local Motors Microfactory, 11 Market Square, Knoxville, TN 37902; phone: 865-249-8280

Water-Repellent Coating

Water repellent coatings are already being used in a variety of energy-saving applications from self-cleaning buildings to more fuel-efficient ships. Now engineers have found a way to use them for reducing carbon emissions from fossil-fuel-burning power plants by improving the efficiency of steam condensers.

As fuel is burned, it produces steam which is fed into a condenser. In the condenser, it cools down and condenses back into water, creating a suction force that helps drive a turbine. Normally, there is a tendency for water to build up on the walls of the condenser pipes, which slows down the cooling process. But coating the pipes with the new water-repellent prevents that from happening and thereby increases the suction force.

The coating itself must be thick enough to withstand the high temperatures and steam, but thin enough so as not to slow down the cooling process in and of itself. A deposition process was developed whereby two gases flow past heated filaments causing a reaction that forms a polymer coating of the optimum thickness.

It has been estimated that the annual reduction in carbon emissions that would be realized by using the coating at just one coal burning power plant would be equivalent to taking as many as 4,000 cars off the road. And with 85 percent of the world's power still coming from steam turbine power plants, the potential global impact could be significant.

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3D Printing Breakthrough

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Not that you need to stop at prototypes. Earlier this month, Stratasys, a manufacturer of huge 3D printers, announced it had built a working electric car using its large format multi-material 3D printer to create all exterior plastic parts, including door panels, bumpers, wheel arches, and some of the interior components as well.

Using 3D printing, sophisticated engineering projects — such as, yes, printing a car — can be designed, built, and brought to market in months, rather than the typical year- or multiyear-long development cycle.

But as I've written before, when breakthrough technologies arrive, they do not simply replace older

ones. We integrate the old and the cutting edge to create new value, and that in turn alters how we relate to the older technology without erasing that older technology completely. Transformation is seldom a simple case of a new tech replacing old tech.

So 3D printing is not going to replace traditional manufacturing; it will instead be integrated with it to provide even more value. Traditional manufacturing has perfected ways to reliably make mass production at a low price. 3D printing — at least for the time being — is far more agile but slow. Designs can be created and altered quickly but the actual process of printing takes time.

All of this is to say we've already leapt out of the realm of prototypes and proof of concept projects. 3D printing is already used for producing final products and will soon be ready for the big league. Think about how you can be pre-active here. Anticipate consumer desires; see the next big thing, and then build it.

Technology-Driven Change Coming To A Market Near You

We're about to witness an explosion of new applications. Rapid prototyping, as well as personalized manufacturing, has allowed manufacturers to innovate with custom-treated plastics and new designs. The spectrum of products that will be available from 3D printers includes household goods, jewelry, clothing, human implants, jet engine parts, and, well, essentially anything.

One of the consequences of that is healthcare will soon be a huge breakout market. I suspect it will become a multibillion dollar business for 3D printing within the next five years.

I've spoken a lot about the Hard Trend — a future fact that is inevitable — of the aging baby boomer population. Personalized medical devices will fit better, perform better, and perhaps reduce medical costs, enabling us to replace everything from pacemakers and pins to new organs created out of organic tissue. 3D printing is a good example of a technology that will help us meet the needs of a generation getting older.

I expect to see 3D printing used cosmetically, as well as to repair failing or non-functioning body parts more and more within the next five years. Replacement bones have successfully been built with 3D printing, and far more complex eye and ear proof of concepts have very recently been developed, although they are not yet ready to bring to market. But the technology and processes will be refined over the next few years – it's far too important and profitable not to fund and push development.

Whether it's fashion objects like designer shoes or replacement body parts, where 3D truly excels is in its ability to enable personalization. This ability to economically create a very limited run of widgets or entire devices — down to a single part run — is what makes 3D a truly disruptive technology. Add in the ability to utilize multiple materials and build structures both vertically and horizontally and you have a technology that will drive change.

Now, it's your turn – how do you envision using 3D multi-material printing? Don't fall into the trap of seeing this as overhyped, a fad, or something that's just going to go away. Instead, ask yourself: How do the potentials of this technology excite and inspire you? What will you make of it?

If nothing else, 3D printing has closed the gap between imagining something and building it. Go and do likewise!

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