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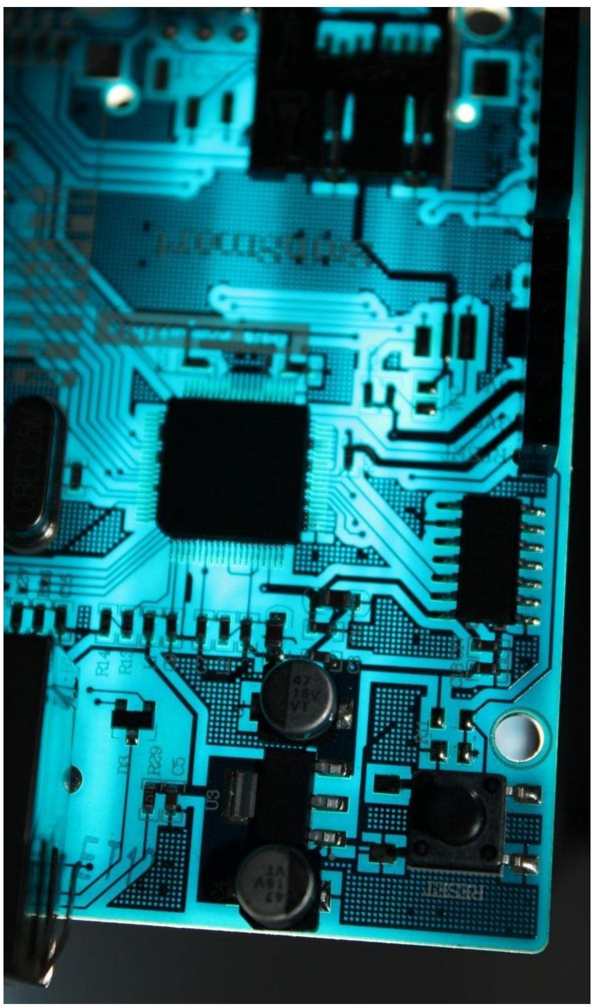


Contents:

Transforming flat elastomers into 3D shapes

Mechanical systems, such as engines and motors, rely on two principal types of motions of stiff components: linear motion, which involves an object moving from one point to another in a straight line; and rotational motion, which involves an object rotating on an axis.

Nature has developed far more sophisticated forms of movement -- or actuation -- that can perform complex functions more directly and with soft components. For example, our eyes can change focal point by simply contracting soft muscles to change the shape of the cornea. In contrast, cameras focus by moving solid lenses along a line, either manually or by an autofocus.

But what if we could mimic shape changes and movements found in nature?

Now, researchers at the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS) have developed a method to change the shape of a flat sheet of elastomer, using actuation that is fast, reversible, controllable by an applied voltage, and reconfigurable to different shapes.

The research was published in Nature Communications.

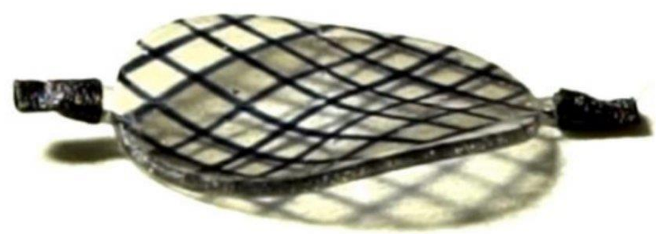
"We see this work as the first step in the development of a soft, shape shifting material that changes shape according to electrical control signals from a computer," said David Clarke, the Extended Tarr Family Professor of Materials at SEAS and senior author of the paper. "This is akin to the very first steps taken in the 1950's to create integrated circuits from silicon, replacing circuits made of discrete, individual components. Just as those integrated circuits were primitive compared to the capabilities of today's electronics, our devices have a simple but integrated three-dimensional architecture of electrical conductors and dielectrics, and demonstrate the elements of programmable reconfiguration, to create large and reversible shape changes."

The reconfigurable elastomer sheet is made up of multiple layers. Carbon nanotube-based electrodes of different shapes are incorporated between each layer. When a voltage is applied to these electrodes, a spatially varying electric field is created inside the elastomer sheet that produces uneven changes in the material geometry, allowing it to morph into a controllable three-dimensional shape.

Different sets of electrodes can be switched on independently, enabling different shapes based on which sets of electrodes are on and which ones are off.

"In addition to being reconfigurable and reversible, these shape-morphing actuations have a power density similar to that of natural muscles," said Ehsan Hajiesmaili, first author of the paper and graduate student at SEAS. "This functionality could transform the way that mechanical devices work. There are examples of current devices that could make use of more sophisticated deformations to function more efficiently, such as optical mirrors and lenses. More importantly, this actuation method opens the door to novel devices that deemed too complicated to pursue due to the complex deformations required, such as a shape-morphing airfoil."

In this research, the team also predicted the actuation shapes, given the design of the electrode arrangement and applied voltage. Next, the researchers aim to tackle the inverse problem: given a desired actuation shape, what is the design of the electrodes and the required voltage that will cause it?



An initially flat thin circular sheet of elastomer with embedded electrodes morphs into saddle shape.
Credit: Image courtesy of the Clarke Lab/ Harvard SEAS.

Harvard John A. Paulson School of Engineering and Applied Sciences
www.sciencedaily.com

Physicists create exotic electron liquid

By bombarding an ultrathin semiconductor sandwich with powerful laser pulses, physicists have created the first 'electron liquid' at room temperature. The achievement opens a pathway for development of the first practical and efficient devices to generate and detect light at terahertz wavelengths -- between infrared light and microwaves. Such devices could be used in applications as diverse as communications in outer space, cancer detection, and scanning for concealed weapons.
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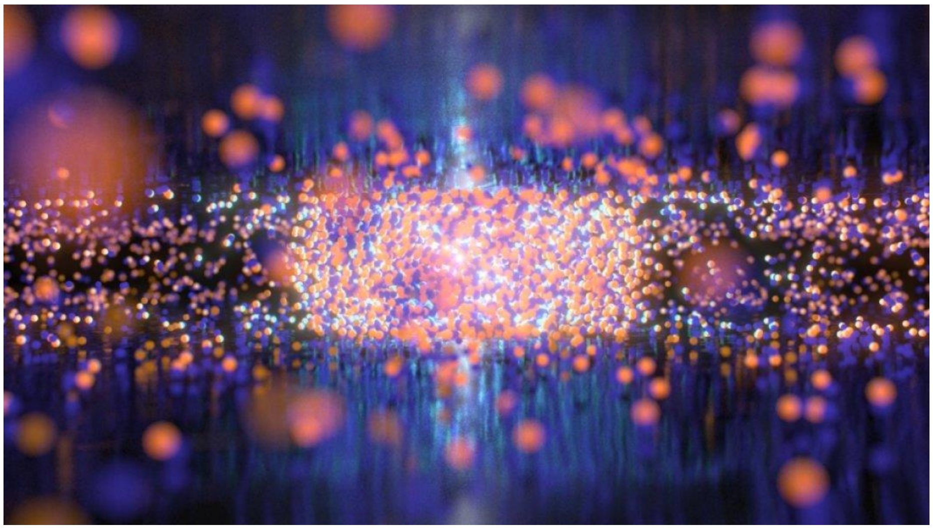
The research could also enable exploration of the basic physics of matter at infinitesimally small scales and help usher in an era of quantum metamaterials, whose structures are engineered at atomic dimensions.

The UCR physicists published their findings online Feb. 4 in the journal Nature Photonics. They were led by Associate Professor of Physics Nathaniel Gabor, who directs the UCR Quantum Materials Optoelectronics Lab. Other co-authors were lab members Trevor Arp and Dennis Pleskot, and Associate Professor of Physics and Astronomy Vivek Aji.

In their experiments, the scientists constructed an ultrathin sandwich of the semiconductor molybdenum ditelluride between layers of carbon graphene. The layered structure was just slightly thicker than the width of a single DNA molecule. They then bombarded the material with superfast laser pulses, measured in quadrillionths of a second.



In conventional electronic devices, electricity requires the movement of electrons (blue spheres) and their positive counterparts, called holes (red spheres), which behave much like the gas molecules in our atmosphere. Although they move rapidly and collide infrequently in the gas phase, electrons and holes can condense into liquid droplets akin to liquid water in devices composed of ultrathin materials.
Credit: QMO Lab, UC Riverside

"Normally, with such semiconductors as silicon, laser excitation creates electrons and their positively charged holes that diffuse and drift around in the material, which is how you define a gas," Gabor said. However, in their experiments, the researchers detected evidence of condensation into the equivalent of a liquid. Such a liquid would have properties resembling common liquids such as water, except that it would consist, not of molecules, but of electrons and holes within the semiconductor.

"We were turning up the amount of energy being dumped into the system, and we saw nothing, nothing, nothing -- then suddenly we saw the formation of what we called an 'anomalous photocurrent ring' in the material," Gabor said. "We realized it was a liquid because it grew like a droplet, rather than behaving like a gas."

"What really surprised us, though, was that it happened at room temperature," he said. "Previously, researchers who had created such electron-hole liquids had only been able to do so at temperatures colder than even in deep space."

The electronic properties of such droplets would enable development of optoelectronic devices that operate with unprecedented efficiency in the terahertz region of the spectrum, Gabor said. Terahertz wavelengths are longer than infrared waves but shorter than microwaves, and there has existed a "terahertz gap" in the technology for utilizing such waves. Terahertz waves could be used to detect skin cancers and dental cavities because of their limited penetration and ability to resolve density differences. Similarly, the waves could be used to detect defects in products such as drug tablets and to discover weapons concealed beneath clothing.

Terahertz transmitters and receivers could also be used for faster communication systems in outer space. And, the electron-hole liquid could be the basis for quantum computers, which offer the potential to be far smaller than silicon-based circuitry now in use, Gabor said.

More generally, Gabor said, the technology used in his laboratory could be the basis for engineering "quantum meta materials," with atom-scale dimensions that enable precise manipulation of electrons to cause them to behave in new ways.

In further studies of the electron-hole "nanopuddles," the scientists will explore their liquid properties such as surface tension. "Right now, we don't have any idea how liquidy this liquid is, and it would be important to find out," Gabor said.

Gabor also plans to use the technology to explore basic physical phenomena. For example, cooling the electron-hole liquid to ultra-low temperatures could cause it to transform into a "quantum fluid" with exotic physical properties that could reveal new fundamental principles of matter.

In their experiments, the researchers used two key technologies. To construct the ultrathin sandwiches of molybdenum ditelluride and carbon graphene, they used a technique called "elastic stamping." In this method, a sticky polymer film is used to pick up and stack atom-thick layers of graphene and semiconductor.

And to both pump energy into the semiconductor sandwich and image the effects, they used "multi-parameter dynamic photoresponse microscopy" developed by Gabor and Arp. In this technique, beams of ultrafast laser pulses are manipulated to scan a sample to optically map the current generated.

University of California - Riverside

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Expert Lecture/Seminars/Courses/Industrial Visits Organized

- TIME institute test on "General Ability" was conducted for TE students under career development cell on 10th January 2019.

- Industrial visit was organized on 11th January 2019 for BE E&TC students related to Mobile Communication subject.

- Prof. S. S. Ansari attended one day seminar on “Defence Industry Stake Holder” at Hindustan Aeronautics Ltd. (HAL), Nashik on 17th Jan 2019.

- Industrial Visit to GMRT, Pune for TE students on 21st January 2019.

- An expert lecture was organized for SE students on "Skill for Professional Resume Writing" on 28th January 2019. Mr. Vishal Jategaonkar was the resource person.

- An expert lecture was organized for BE students on "Entrepreneurial Inputs for Technocrats" on 7th February 2019. Mr. Sunil Chandak (President & Director, Udyogvardhini) was the resource person.

- Industrial Visit to Sivananda Electronics, Nashik for TE students on 8th February 2019.

- An expert lecture was organized for UG, PG students and staff on "IPR commercialization" on 13th February 2019. Dr. O. G. Kulkarni was the resource person.

- Industrial visit was organized on 15th February 2019 for SE E&TC students related to Analog Communication subject.

- Spoken tutorial test on C language was conducted for SE students on 16th February 2019.


- An expert lecture was organized for TE and BE students on "Professional Ethics" on 18th February 2019. Mr. Shrikant R. Karode, General Manager, Crompton Greaves Ltd, Nashik was the resource person.


- Seminar was organized on “Use of MATLAB and Simulink in Engineering Applications” conducted by Mr.Suraj Gawande (Application Engineer, Designtech Systems) on 21st February 2019.

- Workshop was conducted on “Hands-on Arduino” by Prof. Dr. M. P. Satone and Mr. D. D. Khartad for TE students on 23rd and 26th February 2019.

- Prof. S. P. Munot was resource person for National Level Seminar on "Use of ICT in Teaching Learning Process Commerce and Management, Languages, Mental, Moral and Social Sciences" under QIP, BCUD, and SPPU, Pune organized by NSP Mandal's Late Bindu Ramrao Deshmukh Arts and Commerce Mahila Mahavidyalaya, Nashik Road.

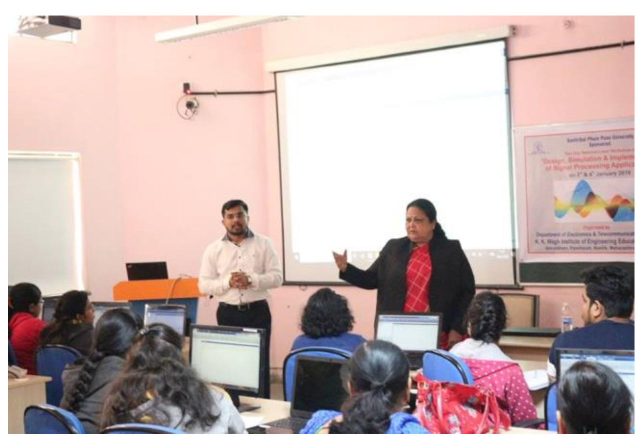
- Ms. Tejal Kapadne form BE Electronics class got 3rd prize in the sport “Team Game”.

Campus Placement

Sr. No.	Name of the Company	No. of students Placed
1.	Infosys	2
2.	Rishabh Instruments	1
3.	Wipro	1
4	Cognizant	2
5	Emerson Export Engineering Center, Nashik	1

National Level Workshop on “Design, Simulation & Implementation of Signal Processing Applications”

A National level workshop was organized on “Design, Simulation & Implementation of Signal Processing Applications” Instrumentation” on dated 3rd & 4th January 2019.



Industrial Training / Seminar/Workshop done by Staff

Sr. No.	Type of Event	Name of Staff	Topic
1	2nd Stage Presentation of ASPIRE Research Proposal in SPPU, Pune	Dr. S. S. Morade	Lip reading of hearing impaired person
2		Mr. S. S. Ansari	BATS/INDIAN MYNA detection and repellent system using wireless sensor network for grapes garden
3		Mr. D. D. Khartad	Prediction and Detection of Obstacle for Vehicle Door Opening using Millimeter Wave Radar System

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Vision

Provide quality education to create engineering professionals of global standards by keeping pace with rapidly changing technologies to serve the society.

Mission

M1: To educate the students with the state-of-the-art technologies and value based education to meet the growing challenges of industry.

M2: To provide scholarly ambience & environment for creating competent professionals.

M3: To inculcate awareness towards societal needs.