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Flexible Electronics

Flexible electronics have evolved in leaps and bounds in the last decade. Soon they could be everywhere.

Image courtesy: https://cdn.macrumors.com/article-new/2019/02/huawei-mate-x800x902.jpg

Flexible Electronics has a long existence and history which goes back to nearly one whole century. The initial activity consisted of patents which included the concepts for flexible-circuit materials and designs. Within the last few decades, these same activities have come into commercial use.

Dr. Ken Gilleo coined the earliest description of flexible circuits. The same was disclosed in a patent by Albert Hansen in the 90s. The materials transitioned from paraffin coated paper to linen paper along with graphite powder and so on. Thomas Edison's lab books also indicated few methods but no evidence of usage as of now. From the past till today, Flexible Electronics involves the integration of both active and passive functions in the processing. The start may be by everyone but it is the Japanese and Shenzhen electronics packing engineers who made flexible electronics employable.

The interesting thing is the discovery that poly-acetylene could be made to conduct electricity almost as well as a metal was actually an accident.

Ref:https://www.lboro.ac.uk/microsites/mechman/research/ipm-ktn/pdf/Technology_review/flexible-circuit-technology-and-its-applications.pdf

What is Flexible electronics?

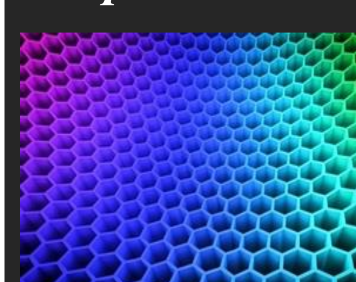
Compiled by Kushal and Shamini

Most of today's electronics use a complex combination of components that can't be bent. For instance, many processors are still etched in silicon wafer that would break upon bending it. However, with elastic printed circuit boards, we can have computers and mobile phones that can bend and stretch without affecting their performance. Unlike regular circuits, these circuits are made up of metal-polymer conductors (MPCs) that are modified to conduct electricity. The metals used are not standard solid conductive metals like copper, gold, or silver, but instead act like gallium and iridium which can take up any shape. Over time these semiconductors have become, stretchier, smaller, and thinner, which is giving rise to new flexible electronics.

Eventually we'll have smartphones that could be worn as a band on our wrists. When it comes to design, the possibilities of flexible electronic devices are endless.

Ref: http://www.youngupstarts.com
https://www.sciencedirect.com/topics/materials-science/electronic-devices

Graphene!



In the last decade, remarkable progress has been made in the field of graphene-based flexible and wearable electronics…

Read more on Pg 3

The revenue of semiconductor industry for the last year is estimated to be $470 billion, and it’s only expected to rise.

What are they made of?

Compiled by Mustakim, Atique and Yash

Flexible electronics, also known as flex circuits, is a technology for assembling electronic circuits by mounting electronic devices on flexible plastic substrates, such as polyimide, PET (polyethylene terephthalate) or transparent conductive polyester. Flexible printed circuits (FPC) are made with a photolithographic technology.

Traditional electronics like ICs or solar cells are built on thick inflexible substrates. Instead, flexible electronics – built on substrates like plastic or metallic foil – can be folded, wrapped, rolled, and twisted with negligible effect on its function.

An alternative way of making flexible foil circuits or flexible flat cables (FFCs) is laminating very thin (0.07 mm) copper strips in between two layers of PET. These PET layers, typically 0.05 mm thick, are coated with an adhesive which is thermosetting, and will be activated during the lamination process.

Each element of the flex circuit construction must be able to consistently meet the demands placed upon it for the life of the product. In addition, the material must work reliably in concert with the other elements of the flexible circuit construction to assure ease of manufacture and reliability.

The base material used is woven fiber-glass impregnated in epoxy resin. For the majority of flex circuit applications, more flexible plastic than the usual network epoxy resin is needed. The most common choice is polyimide, because it’s very flexible, very tough and also incredibly heat resistant. This makes it highly tolerant and reasonably stable in expansion and contraction due to temperature fluctuations.

Polyimide film is the most common insulator material used for flex circuits. It uses the film as the base layer on single metal layer flex circuits and for inner layers of multilayer circuits. It also has the ability to work with most commercially available laminates.

Silicones, hot-melt glues, and epoxy resins are also used when protective beads are added to the flex-to-rigid joins or interfaces (i.e. where the flexible part of the layer stack leaves the rigid part). These offer mechanical reinforcement to the fulcrum of the flex-to-rigid joint which otherwise would rapidly fatigue and crack or tear in repeated use.

Ref: https://crimsonpublishers.com/cojec/
https://link.springer.com/10.1007/978-94-017-9780-1_147

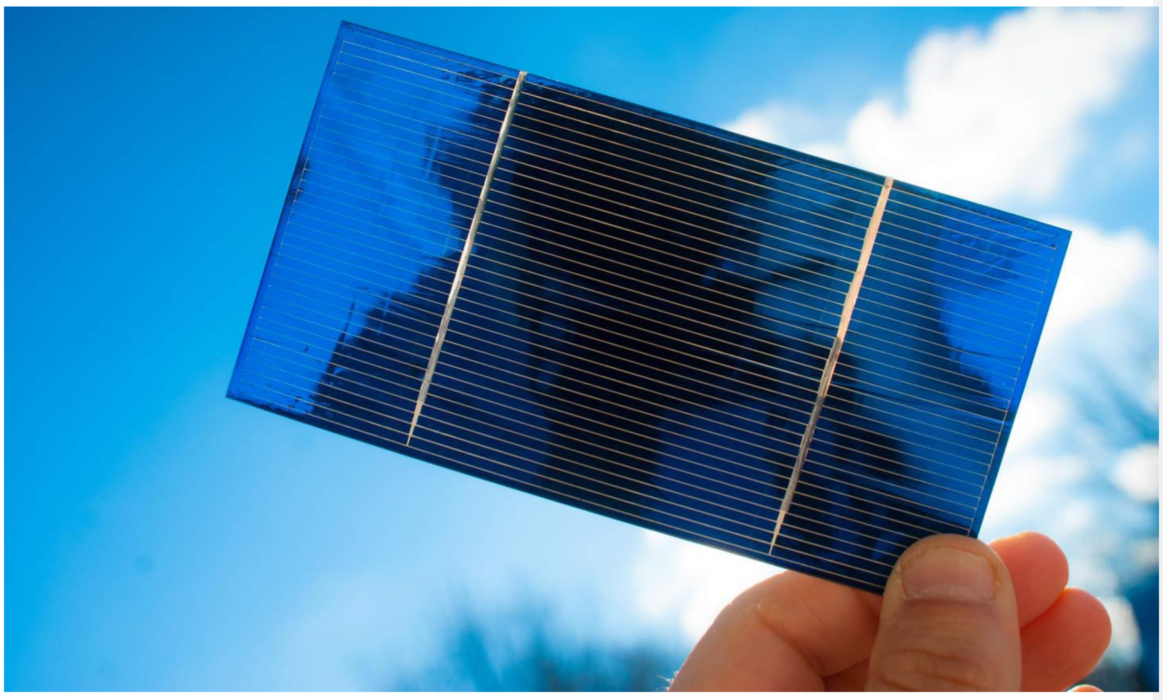
Printable solar cells!

-Compiled by Nihal Kumar

What if, instead of attaching solar panels to your roof, they were built into the fabric of your curtains, or laminated onto your window panes? Or, instead of plugging in your laptop to recharge the battery, you could charge it on the go, via solar power-generating clothes?

You could, thanks to organic photovoltaics, or OPVs—a thin, flexible alternative to conventional, silicon-based solar panels. A special kind of polymer called a conjugated polymer is mixed with a substance known as a fullerene (sometimes called a bucky-ball) to create an active layer. A thin film of this blend goes between two electrodes, one of which is transparent. When sunlight is absorbed by the conjugated polymer, the energy can transfer an electron from the polymer to the fullerene. This makes charge flow through the cell, establishing a voltage between the two electrodes.

Solar panels have the potential to be a much cheaper alternative to those which use traditional. Not only are polymers cheaper, but they’re thin, light and flexible. The Victorian Organic Solar Cell Consortium, a collaboration between the University of Melbourne, Monash University and CSIRO with a number of industrial partners, has been working on developing a flexible, polymer-based solar cell that can be printed using an ordinary printer.



Ref: https://www.science.org.au/curious/technology-future/flexible-electronics
https://www.craftechind.com/use-of-plastic-materials-in-the-construction-industry/

Over 20% efficiency compared with around 18 % for commercial silicon panels

The real challenge is to produce them on the larger scale needed for use in building materials — especially as extremely thin layers need to be precisely laid down, with no pinholes or other imperfections, for the panels to function properly. Making them last long is another issue, as plastics are subject to degradation, especially when exposed to moisture.

You’ll most probably experience initial versions of the flexible panels on small items such as backpacks to charge laptops and other gadgets.

You're going to be surrounded by flexibles!

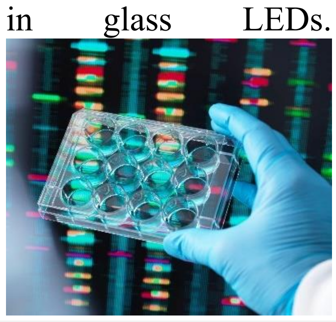
Compiled by Hemant, Tarang and Prachi

Developments in thin, light and flexible electronics new innovations, from curved TVs to glucose-monitoring contact lenses.

In the field of healthcare
A big portion of the medical equipments and devices have to rely on form factor constraints which forces them to use glass, which in turn makes the parts bulky, rigid and fragile. For example, amorphous silicon based X-ray detectors are made up of glass, which causes their weight to reach a few kilograms as per their sizes. A plastic based X-ray detector instead would be significantly lighter..

Foldable phones and roll-up TVs
One more innovation with extensive flexible potential is organic light emitting polymers, or simply OLEDs. It's actually very commonly used. OLED is a high quality flexible display which does not leave a dent in one's pocket.

The display gets its flexibility due to the use of flexible organic transistors as against the rigid amorphous silicon transistors used in glass LEDs.



The optical sensor, which is just 0.3mm thick and can even image veins, can be used for large and small area fingerprint scanning. What makes this tech unique is its twofold authentication of fingerprint and veins. The sensor's even suitable for FBI certification.

Electronics that reflect and imitate the natural world by bending, stretching and flexing can be termed as tech of the future technology as it becomes more and more integrated into our lives, our environments, and even our bodies.

Biometrics
Organic electronics based flexible fingerprint sensors are very thin, light and strong. They can be moulded into different form factors. The world's first 500 dpi flexible fingerprint sensor has been made by FlexEnable on plastic.

Wearables
A field in which the flexible tech can make a big difference is the wearables industry, where we can embed devices onto our bodies and clothes. It could become a less intrusive and more comfortable way of keeping track of vitals of human's real time.

Ref: http://www.flexenable.com/applications/
https://tokoonlineindonesia.id

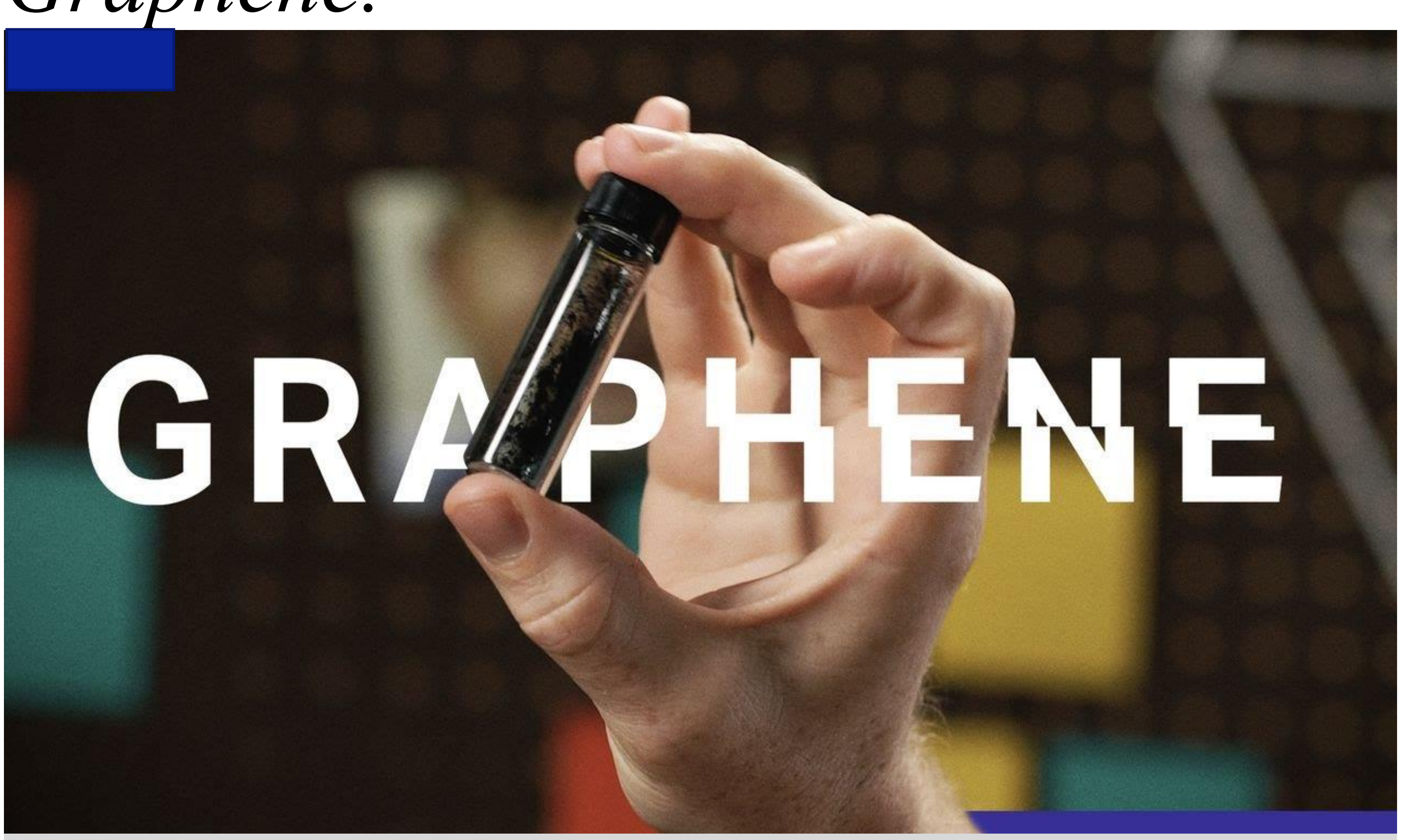
Smartphone with Flexible OLED display

The amazing discovery that polymers are capable of being semiconductors has paved the way for development of flexible screens and printable solar cells which use OLEDs.

A Siemens SMT line can place a component as small as 0.4mm x 0.2mm on a board. It is so tiny you would need a compound microscope to see it.

Don't forget the ***'Wonder material'****, Graphene.*

-Compiled by Nihal Kumar



The market price of Graphene is somewhere around $100 per gram.

Ref: https://iopscience.iop.org
http://www.jos.ac.cn/app/article/app/doi/10.1088/1674-4926/39/1/011007?pageType=en

Graphene with an exceptional combination of electronic, optical and mechanical features has been proved to lead a completely different kind of 2-D electronics. The most exciting feature of graphene is that it is super-thin and can be adhered to any kind of rough surface.

In the last 10 years or so, commendable progress has been made in the field of flexible and wearable electronics which use graphene, demonstrating a variety of applications such as high-speed FETs, touch panels/displays, LEDs, photo-detectors, photovoltaic cells, biomedical sensors, and energy-harvesting devices. With constant R&D, many new strategies are emerging towards the real life implementation of flexible devices based on graphene. Many start-ups and existing industrial enterprises, have started to produce graphene on a scale of thousands of square meters annually for the same. Though the industry is still in its initial phase, very significant progress in large-scale production and certain industrial applications has been noticed.

DEPARTMENTAL ACTIVITIES /ACHIEVEMENTS

ACADEMIC RESULTS

B.E. (2018-2019)

TOPPERS NAME	CGPI	RANK
Negi Pratik	9.28	1st
Patela Vrutika	9.13	2nd
Pal Priyanka	8.76	3rd

T.E. (2018-2019)

TOPPERS NAME	AVG	RANK
Kudva Ajay	9.21	1st
Dubey Alok	9.075	2nd
Garg Garvit	8.98	3rd

S.E. (2018-2019)

TOPPERS NAME	AVG	RANK
Pitodia Abdulmateen	10	1st
Ansari Mustakim	9.585	2nd
Joshi Anushka	8.945	3rd

IEEE Student Branch of VCET won Second Prize in Poster Presentation Competition held at IEEE Bombay Section PHOENIX 1.0, K.J. Somaiya Institute of Engineering and IT, Sion on 11/09/2019.

Heartiest Congratulations to Mr. Vikram Gothal for getting placed in HLS Asia Ltd. with the highest package of 22.43lakhs

Prof. Shaista Khanam and Prof. Trupti Shah of Dept. of EXTC, successfully completed a NPTEL course on “Microprocessor and Microcontroller” with 83% and 76% respectively.

Prof. Shaista Khanam and Prof. Trupti Shah presented paper in IEEE International Conference on ‘Self Defence Device’ with GSM alert and GPS tracking with fingerprint verification for women safety in June 2019, at RVS Technical Campus Coimbatore, Tamil Nadu.

Prof. Shaista Khanam and Prof. Trupti Shah conducted workshop in RGIT on IoT and DSP processor on 19^{th} & 20^{th} of August,2019 under Texas Instruments Innovation Lab.

Prof.Sunayana Jadav and Prof. Trupti Shah successfully conducted a two day workshop on VERILOG in July 2019.

CONGRATULATIONS!!!

INDUSTRIAL VISITS

- **AMUL FACTORY, VIRAR**

The Department of EXTC, in association with IEEE VCET-SB had organized an Industrial Visit to Amul Factory, Virar on 23rd August, 2019 for the students of Third year (EXTC) to give a good exposure to the students about the working of Amul Processing Unit which serves Mumbai and its surrounding regions and is equipped with a 50,000 litre/hour integrated milk reception, processing, online pasteurization, standardization and homogenization facility. A total of 80 students and 4 faculty members visited the site.

- **FOX DOMOTICS, WALIV**

The Department of EXTC had organized an Industrial Visit to Fox Domotics, Waliv on 28th August, 2019 for the students of Second year (EXTC). The main objective behind the visit was to make students aware of applications of IoT, Home Automation and the technology used to manufacture these devices.

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