

Super-slimmed smartphones

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Meet the researchers who have an ingenious idea for removing yet more bulk from phones

Since their invention in the noughties, smartphone design has been dominated by two trends: thinner and bigger.

The two might sound at odds with one another, but smartphone giants like Apple and Samsung have managed to produce phones with slightly bigger screens in slightly thinner cases again and again. Now, chemists are inching closer to making smartphones even thinner with a trick that could change the game entirely: making the battery and the screen one and the same thing.

Researchers from Hong Kong and China have made a battery that doubles up as part of a full colour display. 'The battery and the screen are the two components occupying the largest volume in many electronic devices,' explains Chunyi Zhi, a material scientist from City University of Hong Kong. 'Therefore, an ultimate strategy to minimize the volume of an electronic device is to integrate the battery together with the screen.'

Rethinking components

The colour displays used in smartphones today are liquid crystal display (LCD) screens. They are made up of little dots of coloured light called pixels; when put together, pixels make up the picture on the screen. The screen needs three things to work: a backlight to light it up; a control system to manage how much light is getting through each pixel; and a filter that gives the pixel its colour. Colour is controlled by mixing light of three different colours: red, green and blue.

The researchers decided to try and make a battery that also served as a colour filter. But how do you make a battery flat like a colour filter and produce red, green and blue light with it?

The trick is in the very make-up of the battery. Batteries are chemical cells; they take chemical energy and turn it into electricity. They consist of a positive and negative electrode, called the cathode and the anode, which are connected by a wire and surrounded by an electrolyte. A series of chemical reactions at the electrodes make negatively-charged electrons build up at the anode. The electrons, which repel each other, escape to the positive cathode. But because they're separated from it by the electrolyte, they travel through the wire instead. Just like that, an electrical current has been created.

Since the battery is going in a screen, it needs to be flat. For this, the researchers used an 'interlocking combs' structure; imagine a cathode comb and an anode comb, stuck together with their teeth fitting in between each other. The researchers then made a gel electrolyte from gelatine, which hindered the electrons generated at the anode from escaping through it to the cathode, but also held the flat battery shape. The interlocking-combs structure means that the battery can fit in perfectly as part of the smartphone screen. 'Our technology may dramatically reduce the volume of electronic devices,' explains Chunyi.

A touch of quantum glow

Having managed to make the battery flat, they needed to move on to the second crucial goal: making it give off red, green and blue light. This isn't something batteries normally do. First, they made sure that the electrolyte was transparent so it would let colours shine through. Then, they introduced little particles called quantum dots.

Quantum dots are quite marvellous things. They glow under certain lights – mainly ultraviolet – but the really neat thing is the same quantum dot will glow a different colour depending on its size. This means that the researchers could simply choose one type of quantum dot material (cadmium tellurium in this case) and make two different sizes. The smaller quantum dot glows green, and the bigger quantum dot glows red. Easy!

The final stroke of brilliance was that they didn't need to make blue quantum dots: the gelatine electrolyte gel itself glowed blue under UV light. They managed to make a fully functional, flat battery that could double up as a colour filter by only adding one extra component: cadmium tellurium quantum dots.

There is still some way to go before the tech giants can start to use this screen-battery, however. For example, the battery can't yet hold the amount of energy needed for a modern phone. Chunyi himself is hopeful though not unaware of the challenges: 'I do think quantum dots displays are the next-generation display technology, [when we have solved] the problems of stability, price and environment-poisoning,' he says. For now, at least, the first steps have been taken.

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