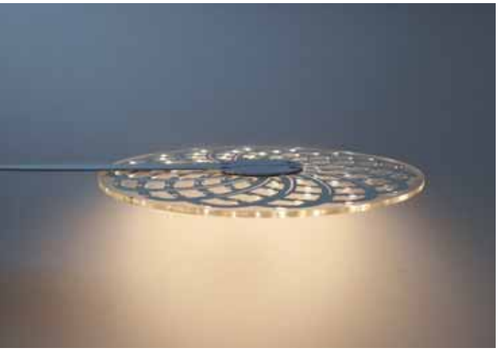
Fusing ideas

It has a diameter of 120 millimetres and serves as a medium for music, videos and LEDs.

LEDs? Correct. The same data storage format developed to store and play sound and video recordings is now being used as a backing material for LED arrays. Not only for technical reasons, but also as a way of offering a creative and unique design solution.



5 watts
400 to 500 lumens
Dimmable
2700/3000/4000 Kelvin
Beam angle without optics < 110°
www.aer-lichtpunkt.de

The arrays comprise as many as 80 LEDs and deliver a luminous flux of up to 500 lumens at a power consumption of 5 watts. LED-CD and SB-CD are based on a transparent circuit board. The LEDs are integrated into the board, allowing the disc to remain ultra-flat. The silver PCB tracks are either vapour-deposited or printed onto the carrier. Electrical contact is effected via conductive pastes, which explains why the array is just 1.8 millimetres thick.

In addition, ultra-flat lens attachments or integrated optics are spaced very close to the light source. Users can define their individual preferences for focussed light or wide-beam distribution, and the product can be supplied to meet user requirements.

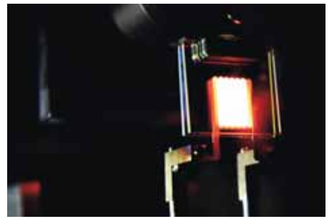
LED technology merges with CDs to create highly original light sources and luminaires. A further advantage is that it is possible to produce the LED discs in large quantities.

The return of (incandescent) light?!

Text: Joachim Ritter

Is the incandescent lamp set to make a comeback? Researchers from MIT are developing a two-stage incandescent lamp in their laboratories which promises to be twice as efficient as an LED!

We live in a fast-moving world. Just over a year ago Shuji Nakamura, one of the team of three to be awarded the 2014 Nobel Prize for Physics, became THE hero of the entire lighting industry – and now his achievement suddenly appears to have been overtaken. Even he himself says that the future lies in laser light... But right now the lighting world seems like it may be taking a turn in another direction, and maybe taking a trip down memory lane.



Researchers at MIT have succeeded in redeveloping the incandescent lamp in their laboratories so that it is twice as efficient as the LED. No joke! At a time when the majority of designers have come to terms with the advantages of the LED, and the entire lighting industry who will be exhibiting in Frankfurt do not appear to think beyond the LED, the scientific journals suddenly come up with this ground-breaking news.

And the first designers and experts from the field are reminding everyone of the advantages of the good old incandescent and the disadvantages of high-tech semiconductor technology.

Here are the facts:

Traditional light bulbs, thought to be well on their way to oblivion, may receive a reprieve thanks to a technological breakthrough.

Incandescent lighting and its warm, familiar glow is well over a century old yet survives virtually unchanged in homes around the world. That is changing fast, however, as regulations aimed at improving energy efficiency are phasing out the old lamps in favour of more efficient compact fluorescent lamps (CFLs) and newer light-emitting diodes (LEDs).

Incandescent lamps, commercially developed by Thomas Edison (and still used by cartoonists as the symbol of inventive insight), work by heating a thin tungsten wire to temperatures of around 2,700 degrees Celsius. The hot wire emits what is known as black body radiation, a very broad spectrum of light that provides a warm look and a faithful rendering of all colours in an environment.

But incandescent lamps have always suffered from one major problem: more than 95 per cent of the energy that goes into them is wasted, most of it as heat. That is why country after country has banned or is phasing out the inefficient technology. Now, researchers at MIT and Purdue University may have found a way to change all that.

Light recycling

The key is to create a two-stage process, the researchers report. The first stage involves a conventional heated metal filament, with all its attendant losses. But instead of allowing the waste heat to dissipate in the form of infrared radiation, secondary structures surrounding the filament capture this radiation and reflect it back to the filament to be re-absorbed and re-emitted as visible light. These structures, a form of photonic crystal, are made of earth-abundant elements and can be made using conventional material-deposition technology.

That second step makes a dramatic difference in how efficiently the system converts electricity into light. A conventional incandescent lamp converts between two and three per cent of the electricity into light, fluorescents (including CFLs) between seven and 15 per cent, and most commercial LEDs between five and 20 per cent. The MIT team claims that the new two-stage incandescents could reach levels as high as 40 per cent.

The first proof-of-concept units made by the team do not yet reach that level, achieving about 6.6 per cent efficiency. But even that preliminary result matches the efficiency of some of today's CFLs and LEDs, and it is already a threefold improvement over the efficiency of conventional incandescents.

The team refers to their approach as "light recycling," says Ilic, since their material takes in the unwanted, useless wavelengths of energy and converts them into the visible light wavelengths that are desired. "It recycles the energy that would otherwise be wasted," says Soljačić.

Bulbs and beyond

One key to their success was designing a photonic crystal that works for a very wide range of wavelengths and angles. The photonic crystal itself comprises a stack of thin layers, deposited on a substrate. "When you put together layers with the right thicknesses and sequence," Ilic explains, "you can get very efficient tuning of how the material interacts with light". In their system, the desired visible wavelengths pass right through the material and on out of the bulb, but the infrared wavelengths are reflected, as if by a mirror. They then travel back to the filament, adding more heat, which is then converted into more light.

"The results are quite impressive, demonstrating luminosity and power efficiencies that rival those of conventional sources including fluorescent and LED light sources," says Alejandro Rodriguez, assistant professor of electrical engineering at Princeton University, who was not involved in this work. The findings, he says, "provide further evidence that application of novel photonic designs to old problems can lead to potentially new devices. I believe that this work will reinvigorate and set the stage for further studies of incandescence emitters, paving the way for the future design of commercially scalable structures".

The work was supported by the Army Research Office through the MIT Institute for Soldier Nanotechnologies, and the S3TEC Energy Frontier Research Center funded by the U.S. Department of Energy.

Should it turn out that the revised version of the incandescent lamp is more efficient than the LED, experience and history has shown that it may well re-conquer parts of the market where the LED has begun to make itself at home.

Not that we will be able to do without LED lighting altogether. It does, after all, offer a number of benefits that the incandescent lamp cannot keep abreast of. In that respect, the 2014 Nobel Prize for Physics quite rightly went to Shuji Nakamura.