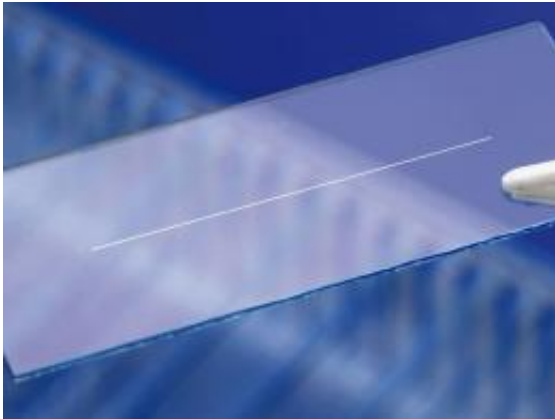


Marvelous light from conductor paths

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In a new process, extremely fine conductor paths can be applied to glass. (© Fraunhofer ILT)

Organic light-emitting diodes are seen as the basis for a new generation of lamps: Large-area lamps that can be randomly shaped and flexibly integrated into interior design. But the "illuminated glass" is still very expensive. Researchers want to optimize the lamps of the future and reduce the price by a new manufacturing process.

A short push on the light switch – and the whole ceiling lights up in a uniform and pleasant color. This “illuminated sky” is not available as yet, but researchers from all over the world are working on it flat out. The technology behind this marvel is based on organic [light-emitting diodes](#), or OLEDs for short. These diodes use special molecules to emit light as soon as current passes through them. Although the first OLEDs have

only recently become available, they are small and expensive. A flat disk with a diameter of eight centimeters costs around Euro 250. Experts of the Fraunhofer Institute for [Laser Technology](#) ILT in Aachen, Germany are working together with Philips to develop a process for making these [lamps](#) distinctly bigger and cheaper – and thus suitable for mass market.

These new lamps are expensive primarily due to the costly [manufacturing process](#). An OLED consists of a sandwich layer structure: a flat electrode at the bottom, several intermediate layers on top as well as the actual luminescent layer consisting of organic molecules. The final layer is a second electrode made of a special material called ITO (indium tin oxide). Together with the lower electrode, the ITO layer has the job of supplying the OLED molecules with current and causing them to light up. The problem is, however, that the ITO electrode is not conductive enough to distribute the current uniformly across a larger surface. The consequence: Instead of a homogeneous fluorescent pattern, the brightness visibly decreases in the center of the surface luminaire. "In order to compensate, additional conductor paths are attached to the ITO layer," says Christian Vedder, project manager at the Fraunhofer Institute for Laser Technology. "These conductor paths consist of metal and distribute the current uniformly across the surface so that the lamp is lit homogeneously."

Normally the conductor paths are applied by energy-intensive evaporation and structuring processes, while only a maximum of ten percent of the luminous area may be covered by conductor paths. "The large remainder including the chemical etchant has to be recycled in a complicated process," explains Christian Vedder. This is different in the new process from the researchers from the Fraunhofer Institute for Laser Technology. Instead of depositing a lot of material by evaporation and removing most of it again, the scientists only apply precisely the amount of metal required. First of all they lay a mask foil on the surface of the ITO electrode. The mask has micrometer slits where later the

conductive paths are supposed to be. On this mask the researchers deposit a thin film of metal made of aluminum, copper or silver – the metal the conductor path is supposed to be made of. Subsequently a laser passes over the conductor path pattern at a speed of several meters per second. The metal melts and evaporates while the vapor pressure makes sure that the melt drops are pressed through the fine slits in the masks on to the ITO electrode.

The result are extremely fine conductor paths. At up to 40 micrometers, they are distinctly narrower than the 100 micrometer conductor paths which can be produced with conventional technology. "We have already been able to demonstrate that our methods works in the laboratory," says Christian Vedder. "The next step is implementing this method in industrial practice together with our partner Philips and developing a plant technology for inexpensively applying the conductor paths on a large scale." The new laser process could be ready for practical application in two to three years.

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