LASER-BASED PRODUCTION OF METALLIC CONDUCTIVE PATHS

Task

Conductive paths collect and distribute electricity on poorly or non-conducting surfaces of OLEDs, solar cells, heated windows, etc.

In most cases the metallic paths can only be produced conventionally with a great deal of effort, incurring high costs for plant, equipment and energy. Electrical conductors in an OLED, for example, are produced subtractively, by photolithographic removal of aluminum previously sputtered onto the surface. More than 90% of the material applied in a cost-intensive high-vacuum sputtering process is removed using etchants. To preserve the OLED's homogeneous luminosity, the conductive paths need to be as narrow as possible. This same requirement also applies to solar cells, although less for eye-appeal than for technical reasons: in this case the conductive paths occupy the silicon surface important for the production of electrical energy. They are currently made by screen printing silver pastes and thermally treated in a furnace process.

The aim is to apply metallic conductive paths on surfaces made of glass, silicon or other materials by means of an innovative, additive laser process which is energy- and resource-efficient.

Method

A mask foil is placed on the substrate which represents the negative of the required conductive path geometry. A donor foil is then attached, providing the material for the conductive path to be produced. This can be aluminum, copper, silver or a similar material. The assembly is fixed in place and charged with laser radiation along the mask geometry. A mixture of melt droplets and vapor then forms, which is transferred from the donor foil onto the substrate. The solidified composite constitutes the conductive path, whose geometry is determined by the mask. A further improvement will be the integration of the mask into the donor foil.

Results and Applications

The technique produces metallic conductive paths made of aluminum, copper, silver or similar materials, in widths between 40 and 120 µm, thicknesses between 3 and 15 µm and with a maximum sheet resistance of 0.05 Ω/sq. The process takes place in ambient atmosphere at a speed of up to 2.5 m/s and can be used to make conductive paths for OLEDs, heated windows, solar cells, etc.

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1 Conductive path on glass.
2 Conductive paths on silicon, comparison of a conventionally screen-printed (above) and a laser-produced conductive path (below).