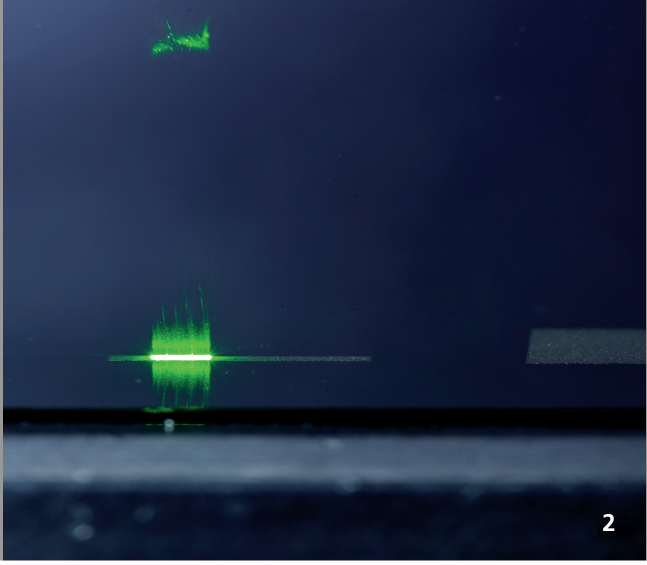

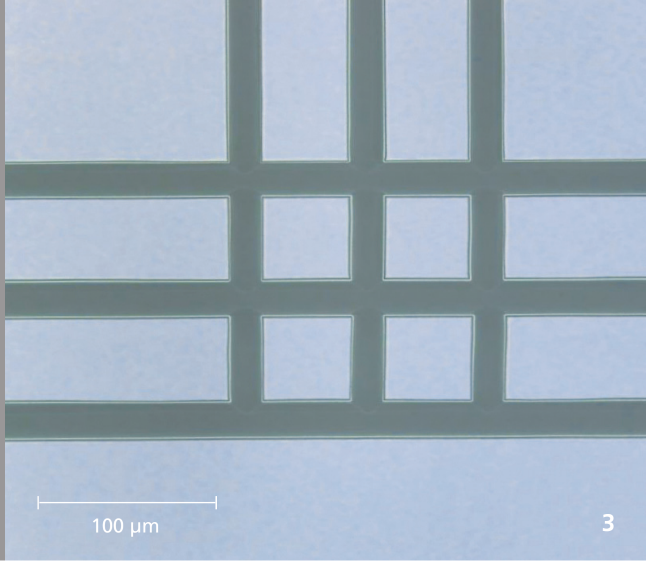

LASER ABLATION OF BARRIER LAYERS IN OLED PRODUCTION

Task

Organic light emitting diodes (OLED) are a lighting technology with great potential for many applications. For their production, the components need to be encapsulated to be oxygen- and vapor-proof, which largely determines the lifetime of the organic materials. The most promising solution is the so-called thin-film encapsulation, in which thin inorganic layers or organic-inorganic layer stacks hermetically seal the OLEDs. For their subsequent contact with the electrodes, this encapsulation must be removed locally, but the electrodes must not be damaged and the barrier effect must remain effective.

Method

The transparent encapsulating layer is made of silicon nitride or other ceramics that have typical layer thicknesses of 300 nm to 1 µm. In the contact area the electrode is located directly below the barrier, and is made of a transparent, electrically conductive material such as indium tin oxide (ITO). With ultrashort pulsed laser radiation with a pulse duration range of some 100 fs to 10 ps, the transparent barrier layer was removed and the process examined without the transparent electrode being impaired in its conductivity.

Result

The sheet resistance of the electrode is typically 10 Ω□. This value must remain after the barrier layer has been ablated. When laser radiation with pulse durations of about 10 ps and a wavelength of 532 nm is used, the threshold fluence for a planar ablation is approximately 0.3 J/cm^2. The layer is ablated and the sheet resistance of the electrode does not increase significantly within a process window of approximately 0.3 J/cm^2. The area rate is 78 cm^2/min at an average power of less than 10 W. In this way, a more robust and productive process is possible, which can be used in industrial environments.

Applications

Many applications of thin-film technology can greatly profit from the selective ablation of thin layers from underlying layers at high area rates and without functional damage. The process developed in this project can be used in organic electronics and thin film photovoltaics, but also in other fields, in which thin layers are deployed for, e.g., wear protection.

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2 Selective ablation of a layer of a layer stack.

3 Multi-beam ablation of ITO film on glass.