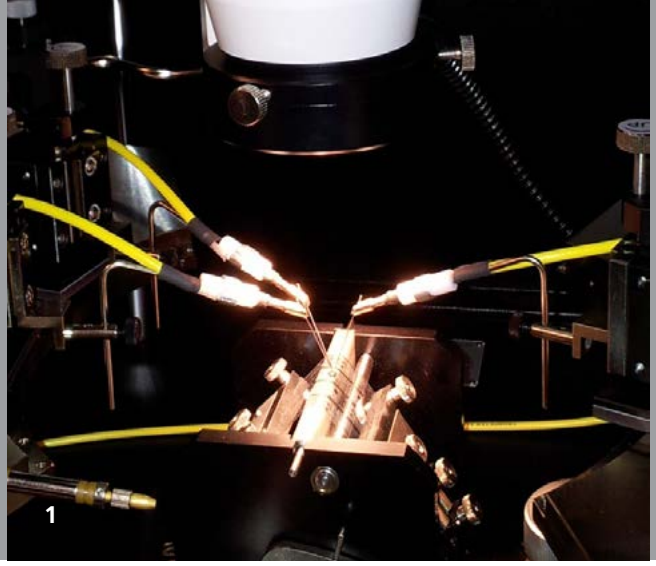

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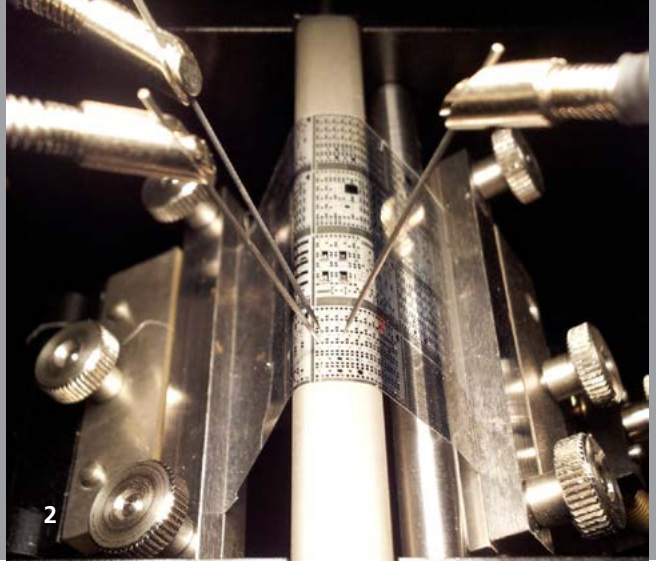

2

MEASUREMENT OF FLEXIBLE TFTs UNDER BENDING LOAD AND TENSILE STRESS

The demands made of displays and touchscreens are constantly growing: they should be flexible, bendable and rollable. Applications of this kind have to deliver challenging optical, electronic and mechanical properties. For this reason a new measuring station has been developed at the Fraunhofer IST with which flexible electronic components can be studied. This is an important measuring instrument for upcoming "wearable" electronics if prediction of the durability of flexible components is to be possible

Measuring set-up

The set-up for measuring the properties of flexible electronics under loading by bending and tension can be seen in Fig. 1. The test pieces used here are 50 mm film sections with mounted thin film transistors held on both sides by a clamp. On one of the clamps there are two springs with a defined spring constant with whose help a defined length change can be set. A bending device in the central part of the measuring set-up enables the stretched film to be bend additionally with radii in the range of 2–10 mm. In this way the thin film transistors (TFTs) are subjected to define tensile stresses and bending load under which measurements can then be taken of their electrical properties.

Behavior of the thin film transistors (TFTs) in the bend and stretched states

The diagram to the right presents a comparison of the properties of a thin film transistor which were measured under bend state with bending radii of 3, 4 and 10 mm (without elongation). At this stage of deformation the characteristic curve of the TFTs exhibits only very minor changes. In the next stage the TFTs bend over the flexible substrate (radius 4 mm) were also measured in the elongated state. By way of example, current/voltage measurements are shown. Starting in the relaxed state, elongation was initially increased in steps (0.2 % – 0.3 % – 0.5 % – 0.8 % – 1.5 %) and then successively reduced again.

As the strain increases, the TFT curves show no major changes up to a 0.8 % change in length but from an elongation of 1.5 % the transistor suffers damage. However as elongation decreases there can be a certain amount of recovery provided no cracking has yet developed. A plastic deformation (without cracks) of the TFTs or substrates would therefore not impair the functional ability of the component.

Outlook

The successful creation of the measurement station means that in future it will be possible at the Fraunhofer IST to optimize the mechanical stability of thin-film transistors under different bending states and tensile stresses.

The project

The measuring set-up has been developed and used as part of the ORAMA EU research project, and sponsored by the European Commission within the 7th EU Research Program.

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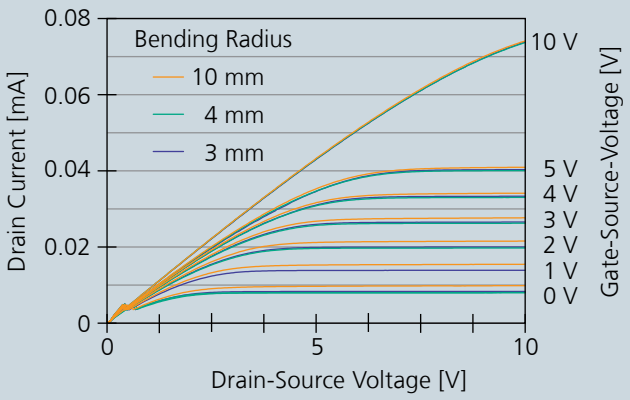
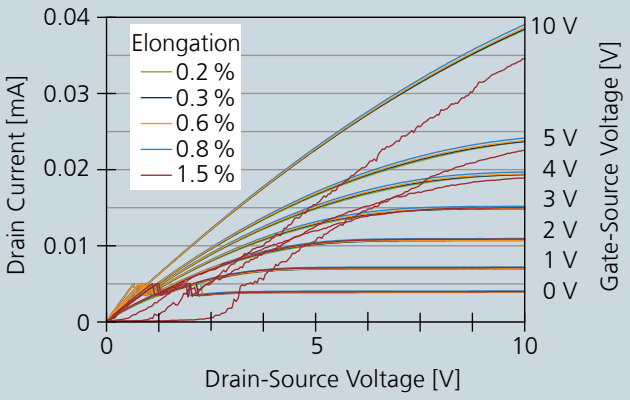
1+2 *The set-up for measuring flexible electrodes on bend and stretched film.*

Comparison of the drain current and the drain-source voltage of a transistor for different gate-source voltages and bending radii.



Comparison of the drain current – drain-source voltage characteristics of a transistor (bending radius 4 mm) for increasing elongation.



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