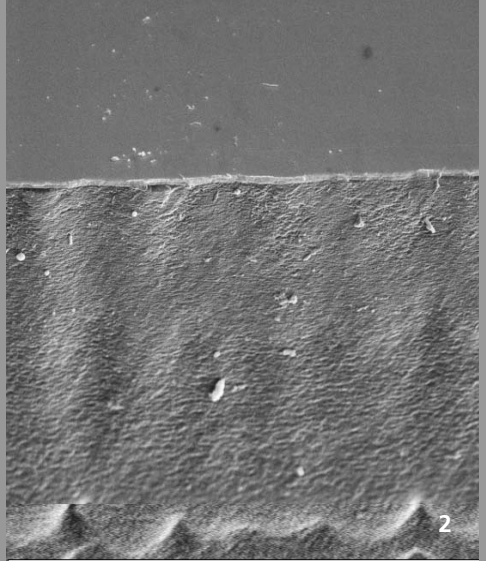
1



2

ABLATION CUTTING OF SILICON WAFERS WITH ULTRA-SHORT PULSED LASER RADIATION

Task

Micro-electronic components, such as LED chips, are currently produced in a batch process, the state-of-the-art. This means that a multitude of identical components are processed on a silicon wafer and subsequently separated from it. In the course of continuous miniaturization of electronic components, the dimensions of component parts are shrinking, which means, in turn, that conventional manufacturing techniques to separate components from wafers are reaching their processing limits. In contrast to this, ablation cutting with ultra-short pulsed laser beam sources offers significant advantages due to the gentle and selective ablation regarding separation line widths and modulus of rupture of the cut component part.

Method

Through the use of ultra-short pulsed laser radiation in the fs and ps range, Fraunhofer ILT is pursuing a direct ablation process as an approach for wafer dicing. First, in fundamental ablation tests, the influence of different wavelengths and beam forms was examined and an ablation model set up. Furthermore, the limits of laser power in combination with spot velocity were established in extensive investigations, which led to an optimal cutting result. The process parameters identified in this way were finally investigated as to their scalability. The scaling occurred by increasing pulse repetition rates together with quick beam deflection using a polygon scanner.

Result

The ablation with ultra-short pulsed laser radiation led to a lowering of the separation line widths down to 25 µm with a very homogeneous cut edge quality and a marginal heat-affected zone. Beam sources with high pulse repetition rates in the MHz range can be made useful for the application through the use of a polygon scanner.

Applications

The results generated can be implemented, in particular, in the field of LED manufacture to increase the chip yield per wafer and, thus, the production efficiency significantly. Since the cut edge quality also can be improved, the chip's modulus of rupture increases, which leads to enhanced process stability.

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Contact

Dipl.-Ing. Dipl.-Wirt.-Ing. Christian Fornaroli
Telephone+49 241 8906-642
christian.fornaroli@ilt.fraunhofer.de

Dr. Jens Holtkamp
Telephone+49 241 8906-273
jens.holtkamp@ilt.fraunhofer.de

1 Polygon scanner.

2 Cut edge of a separated silicon chip.

Fraunhofer Institute for Laser Technology ILT, www.ilt.fraunhofer.de
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