Laser Induced Forward Transfer (LIFT)

Ralph Pohl, Gert-Willem Römer
R.Pohl@utwente.nl
University of Twente, Laboratory of Applied Laser Technology

Background

The LIFT process (1) is based on an ablation process which results in a deposition of various types of materials, mostly metals. The setup consists of the material which is to be transferred (Donor material 2), a substrate on which the donor material is coated (Carrier 3) and a second substrate on which the donor material is deposited (Receiver 4). For the LIFT process, a laser beam (5) is focused through the carrier onto the donor layer. The incident laser beam is absorbed within a thin layer of the donor material. Depending on laser fluence, the donor material is melted and may be vaporized. Due to the melting process and the arising pressure, the donor material is propelled towards the receiver. Size and quality of the deposited features (6) depends on the processing parameters.

Experimental Setup

For research purposes the setup was designed to be as versatile as possible. The current setup consists the following sections:

1: MAX311D - Closed-Loop 3-Axis NanoMax Stage to adjust the separation between Donor and Receiver. 5 nm feedback-controlled step size.
2: APR001 Pitch and Roll Tilt Platform to adjust the alignment between Donor and Receiver. 0.003 degree accuracy.
3: The red slides represent the Carrier and Receiver substrates mounted by vacuum bearings.
4: PT1-Z8 Motorized Translation Stages used to move the Carrier/Donor in the x-, y-plane. Step size <1 µm.
5: Optical measurement device to determine the alignment of the Receiver with respect to the Carrier.
6: Objective and tube of a microscope setup for optical analysis of the LIFT process.

Applications

The basic applications can be found in the semiconductor industry, or in any field where a high resolution direct write technique is required. Especially the printing of conductive lines (1) and the filling process of Through Silicon Vias (TSVs) (2) are of interest. To create conductive lines, multiple droplets are deposited with a defined overlay. For the TSV filling, several droplets are subsequently deposited on the bottom of the TSV. In both cases, the electrical properties are of major interest. Hence, imperfections in the deposited features have to be minimized.

Figure 1: Sketch of the LIFT process.

Figure 2: CAD sketch of the LIFT setup.

Figure 3: Sketch of LIFT applications.