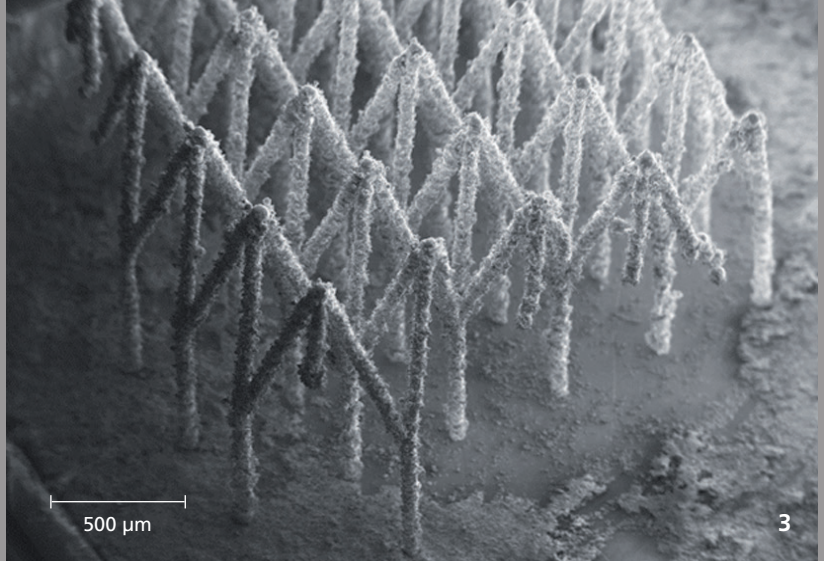

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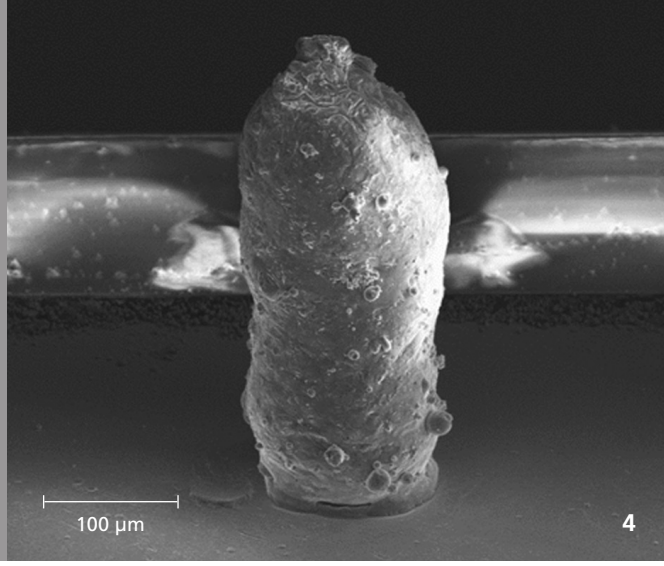

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DEVELOPMENT OF A NEW ASSEMBLY AND PACKAGING TECHNOLOGY FOR POWER CONDUCTORS BY MEANS OF SLM

Task

Modern metallized power semiconductors allow, even at high voltages (voltage class in the range of 3 kV), high switching frequencies (up to 100 kHz). Three factors, however, cause significant parasitic switching currents: the reduced size of the passive components and, thus, the overall size of the power electronic system as well as the fast response times of modern equipment regardless of the semiconductor material, e.g. Si, SiC or GaN. These currents arise due to the coupling capacitances and stray inductances of the connection materials between the vapor-deposited metallization layer and the contact wires. These currents need to be reduced so as to enable an increase in the switching frequencies of the power semiconductors. Moreover, the lifetime of the switching elements is significantly reduced on account of the thermal resistance of the compound materials to the connections and the resulting power losses and temperature gradients at the contact surfaces. Thanks to SLM, contact structures from materials identical to the metallization layer can be built directly on the surface of the power semiconductors. This way, compound materials do not need to be used and the parasitic switching currents can be reduced. The contact structures (approx. 100 µm in diameter and 3 - 5 mm in height) are built on an aluminum metallization layer having a thickness of about 15 µm. The underlying Si substrate may, however, not be damaged in the process.

Method

To create damage-free contacts, Fraunhofer ILT conducted fundamental studies on the production of structures using point exposure of AlSi10Mg with a particle size < 25 µm on an aluminum metallization layer. A new method was developed to apply the powder so as to improve the quality of the first layer of powder, since the quality of the powder application on the metallization layer has proven crucial for the integration of contact structures built without damaging the semiconductor. There, the powder is applied as a suspension on the metallization layer; a high quality powder coating remains after the liquid portion evaporates. The institute also examined different building strategies of various contact structures.

Result

Contact structures with a diameter from 100 - 200 µm, a height of 3 - 5 mm and a gap of approx. 100 µm could be built. A functioning bipolar transistor with an insulated gate electrode could successfully be contacted with the structures thus generated.

Applications

Improving the switching times of semiconductor diodes is an important research area in modern electronics.

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3 Contact structure generated with SLM on an AL metallization layer.

4 Enlarged detail of a contact structure.