Precision structures of silver conductive adhesive

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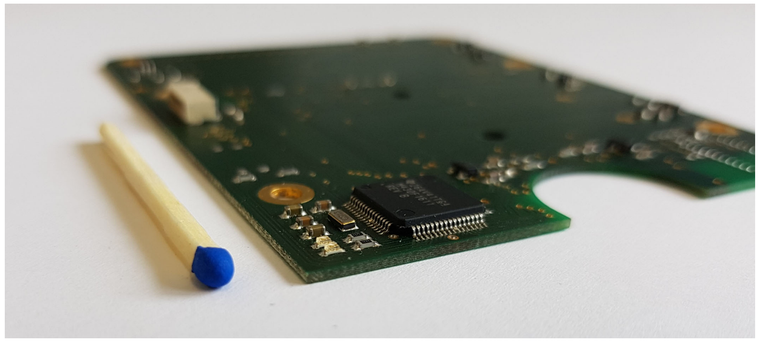
Microdispensing of conductive liquids in the nanolitre range

The progressive miniaturisation of systems in the Industry 4.0 era is reducing the available contact surfaces on components, e.g. for establishing electrical contacts. Electrically conductive adhesives are thus required in many industries, which have to be applied in very small volumes. These liquids need to be dosed at high frequencies and with a high level of reproducibility at a volume of just a few nanolitres. Various different dispensing systems are suitable for these requirements. Liquids containing particles such as silver conductive adhesives and soldering pastes can also be flexibly applied to curved surfaces with such dispensing systems.

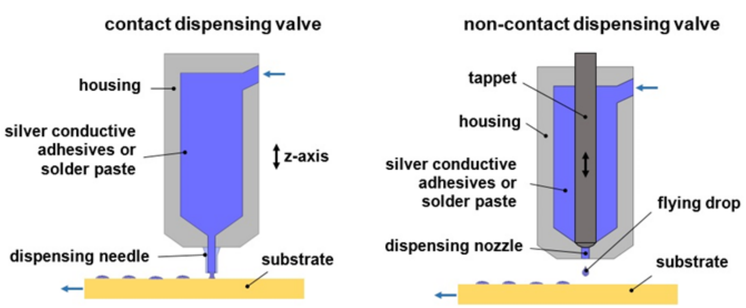


By applying very small drops of silver conductive adhesive and soldering paste, contacts can be formed between a diverse range of electronic components. Conductor tracks can also be applied to components with various different geometries. Miniaturisation will require even smaller structures in the future.

Contact and non-contact dosing

It is not easy to apply very small droplets onto curved surfaces using current processes such as screen printing. Replacing components on circuit boards using these processes is also a difficult task. Innovative concepts and solutions are thus essential to fill this gap.

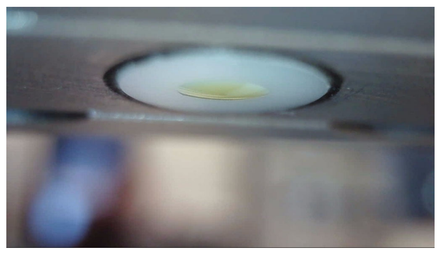
Precision dosing valves can be used to apply the required liquid to any surface and also for replacing components. A distinction is usually made here between contact and non-contact dosing valves. In the case of contact valves, the liquid flows through a dispensing needle and is thus directly applied to the substrate. In contrast, non-contact dosing valves enable free-flying droplets to be applied to the substrate. Non-contact dosing systems are utilised in ink jet printing. They can also be used to some extent to dose low viscous liquids containing particles. However, highly or high viscous liquids cannot be dosed using the principles behind ink jet printers. Tappet-nozzle principles are primarily used for the non-contact dosing of high viscous liquids.



Irrespective of the dosing system, the dispensing volume is dependent on various different parameters and stable conditions can only be guaranteed within narrow limits.

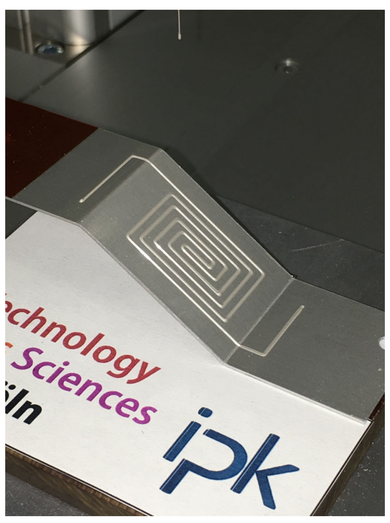
Using contact dosing valves and dispensing needles with optimised inlet areas, relatively small volumes of conductive silver adhesive can be applied. These very small drops typically have a diameter of just a few hundred micrometres. Numerous tests have demonstrated that the diameter of the drops is dependent on the feed pressure, diameter of the dispensing needle and the distance between the dispensing needle and the substrate.

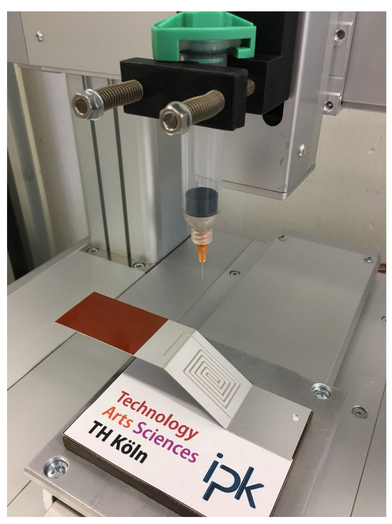
In the case of non-contact dispensers, the break off behaviour of the nozzle plays a particularly decisive role. A special stroboscopic droplet observation setup was used for these tests. Alongside the break off behaviour, it can also be used to determine the volume and speed of the drops.



3D printing of conductive structures

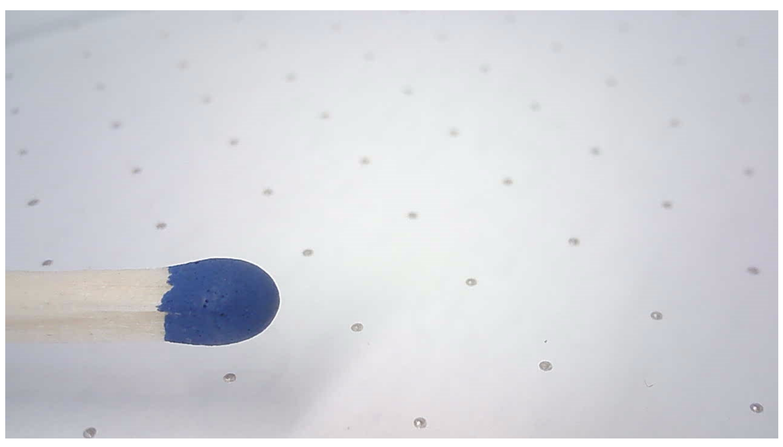
To generate three-dimensional electrically conductive structures, these dosing valves can be applied on corresponding positioning units. This enables conductor tracks to be precisely applied to curved or angled components.





The dosing of electrically conductive adhesives is currently very limited due to the fact that they frequently contain silver particles. These particles, which can have a diameter of 20 µm to 50 µm, quickly damage or block the dosing valve due to their abrasive effect.

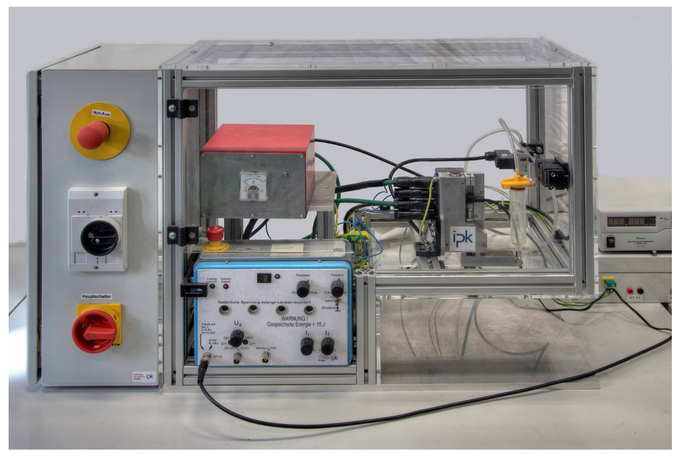
Following intensive testing, the conditions that guarantee the production of a reproduceable dosing volume for various high viscous liquids were identified.



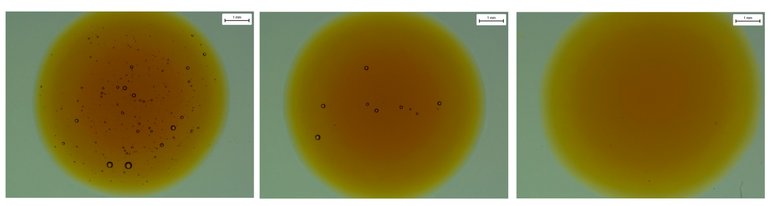
Smart project development

In the specialist field of design technology, we are also engaged in applied research to identify innovative concepts for the development and design of smart precision systems.

In the production of smart products, it is often necessary to join components, establish electrical contacts between them and also take measures to reduce friction. The process for applying e.g. oils, grease, adhesives, etc. plays a decisive role in these applications. For this purpose, very small amounts of these types of media have to be separated, fed to the valve and applied to the carriers.

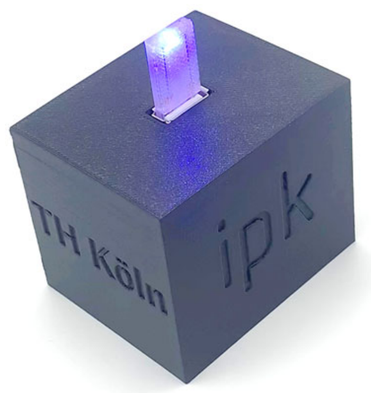


Air pockets in the liquid containers can prove detrimental to the dosing process. These air bubbles can result in the liquid leaking, especially in pressure-time dosing valves. This occurs when the liquid in the container, e.g. a cartridge, is no longer held at a predefined pressure. At these times, the air bubbles can expand again and allow the liquid to flow out of the dispensing needle. Furthermore, the air bubbles can result in incorrect dosing or significant deviations in the dosing volumes. Solutions for reducing the air bubbles in the cartridges have thus been developed at the institute. Using a special degassing device, it was possible to significantly reduce the gas bubbles that had dissolved in the cartridge.
In addition, various different sensors can be used to detect the flying drops of liquid.



Development projects and collaborations

In the development of these types of projects, we collaborate with various different industrial companies and make joint applications for research and development grants. In agreement between the partners, the findings from these projects are published in corresponding journals or used to file a patent application.



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