Biotechnology | Diagnostics | Materials Science and Engineering | Technology Offer

Glass perfectly covered or bonded – novel lamination of thin polymer layers on structured surfaces

Field of application

Fluid-mechanical components (fluidics / microfluidics) are subject to ongoing enhancement. These components are used in a wide variety of fields, such as chemistry and medicine, but also in aeronautical and space technology or in everyday objects (switching devices). In contrast to conventional lamination processes, the new lamination method presented here produces the laminate separately from the substrate. Therefore, it is the ideal solution for glass, ceramic and metal substrates, which may contain microstructures, such as channels.

State of the art

The trend in microfluidics towards ever-smaller micro-structure dimensions on the substrates results in ever-higher requirements concerning the device manufacturing methods. Previously the films were glued directly to the substrate or a polymer layer was applied directly to the substrate. In the new process, the laminate layer is produced separately from the substrate and then bonded to the substrate. It is thus possible to eliminate the disadvantages of the conventional, sometimes very complex, manufacturing technique, in which for example the thermoplastic substrate and the laminate are connected by ultrasonic welding or by using very high temperatures. Another problem which arises when using this established procedure is the narrowing or clogging of the substrate's structures when applying the polymer layer directly to the substrate. The layer thickness of the polymer can thus not be adjusted satisfactorily.

Innovation

Researchers at Karlsruhe University of Applied Sciences have now succeeded in developing a gentle, simple and cost-effective lamination method which does not affect the microstructures on the substrate. In comparison to conventional methods, the laminate can be bonded to the substrate at low temperature and low contact pressure. In a first step, a polymer is produced in the desired layer thickness (in the range of 0.5 to 1000 µm) using a working stamp. It is then transferred to the substrate in order to completely or partially cover the generated channel structures, for example. This method can also be used to create multilayer systems (stacks). The laminate itself can be provided with a functional structure with the aid of a structured stamp suited to this purpose. When using glass (as a substrate for biomolecules), it is the ideal method for diagnostic applications.
From precisely adjustable layer thickness (e.g. light transmission for microscopic detection methods) to structured laminated functional layers and variable sealing of the channels (open and closed sections) – the advantages of this new method, especially in the field of microfluidics and lab-on-a-chip technology, are obvious.

Your benefits at a glance

- ✓ Simple and cost-effective method
- ✓ Suitable for various substrate materials, especially glass
- ✓ Both monolayers and multilayers (stacks) can be produced
- ✓ Variable layer thickness of the laminate, precisely adjustable over a very large range
- ✓ Both the laminate and the substrate may contain structures
- ✓ No narrowing of structures due to lamination

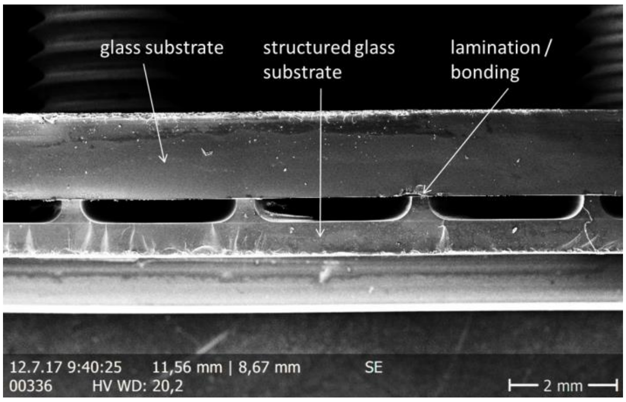

Figure 1: SEM picture of a cross-sectional view (abort edge) of a glass substrate bonded to a structured glass substrate [Image: Karlsruhe University of Applied Sciences].

Patent portfolio

A German (DE) patent application is pending.

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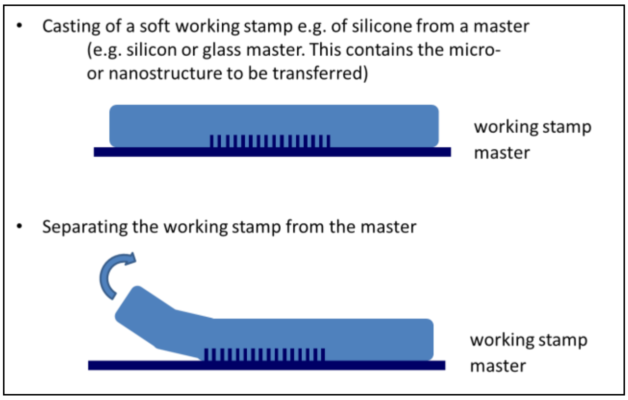

Figure 2: Microstructured lamination:
Step 1 - Production of the working stamp.

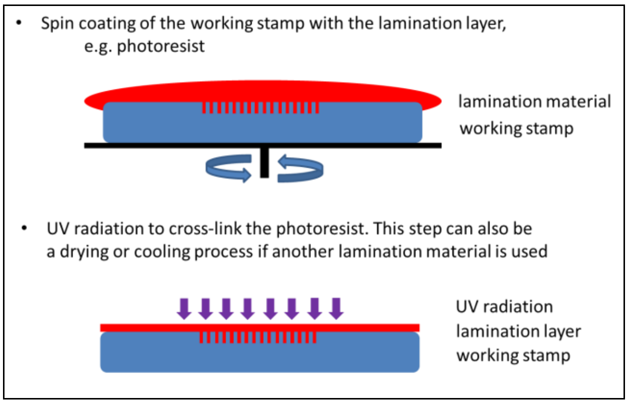

Figure 3: Microstructured lamination:
Step 2 - Production of the lamination layer.

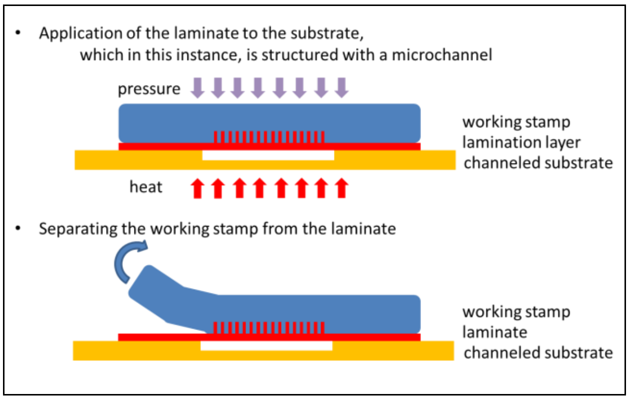

Figure 4: Microstructured lamination:
Step 3 - Application of the laminate.

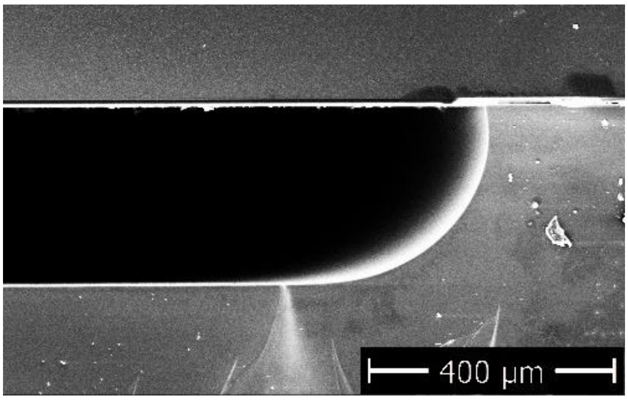

Figure 5: SEM picture of a cross-sectional view (fracture edge) of a glass substrate bonded to a structured glass substrate.

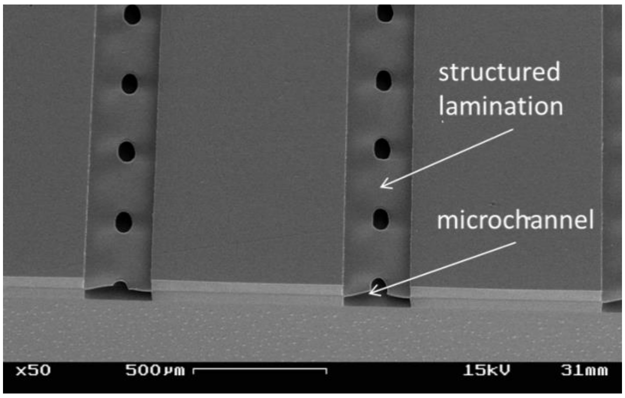

Figure 6: An additional layer may be laminated in order to obtain two channels on top of each other, so that the microfluidic component can be used e.g. as a mixer or filter.

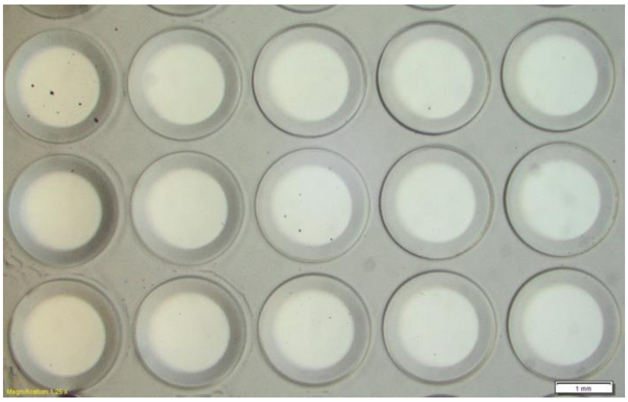

Figure 7: Light micrograph of laminated (covered) microwells in a glass substrate (scale bar 1 mm) [Images: Karlsruhe University of Applied Sciences].

Technology transfer

Technologie-Lizenz-Büro GmbH is responsible for the exploitation of this technology and assists companies in obtaining licenses.

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