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*Possible application for haptic structures in glass.*

Smartphones and tablet devices have permanently changed the way in which one interacts with applications. With their unique haptics and high value, glass surfaces are also perceived to have positive characteristics such as quality and innovation. One advantage of the integration of structured interaction surfaces made of glass into products is that such glass haptic structures allow the control elements to be discovered even without visual contact. They allow operating the control to be performed by direct feel.

Fraunhofer IWM develops solutions for process engineering that allow local structures to be integrated into glass surfaces. This lays the foundation for high-quality control elements and control panels to be integrated directly into glass.



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## LOCALIZED HOT EMBOSSED GLASS FOR INNOVATIVE USER INTERFACES



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The Fraunhofer IWM is the point of contact for industry and public contracting bodies concerning component and systems reliability, safety, durability and functionality. The Fraunhofer IWM's »mechanics of materials« services focus upon identifying weaknesses and defects in materials and components, determining their causes and building upon this to realize solutions – including material development, manufacturing processes and testing procedures – that lead to the efficient and reliable use of components.

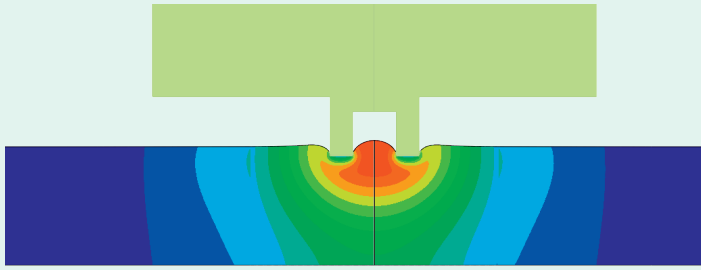
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Simulation model for embossing procedure.



Possible application for haptic structures in glass.



Haptic structures in glass.

### Simulation-based hot embossing process from Fraunhofer IWM

The shaping of glass is largely determined by its visco-elastic properties, which in turn are a function of temperature. To achieve the required final contours, both the relaxation behavior of glass and the formation of internal stresses must be controlled. A numerical description of the process helps to clarify this problem and to allow the controlled heat introduction.

### Process development

An embossing process has been developed at Fraunhofer IWM that enables different structural geometries to be introduced into various thicknesses of glass. The areas to be shaped are locally heated using a CO<sub>2</sub> laser, and thus the precise amount of heat required, derived beforehand using numerical simulation, can be controlled. This allows the predefined final contours to be accurately obtained.

### Possible applications

Applications for haptic structures in glass are many and diverse. Structures previously realized in plastic or metal on glass surfaces can be integrated directly into the glass area. This is particularly useful for glass walls and glass doors and for control panels in elevators, where elements such as light switches and controls can be integrated directly into the glass surface itself. Control elements in vehicles can also be manufactured in glass. For these applications, glass has advantages such as stability, being easy to clean, being free of corrosion and resistance to aging.



### Available structural geometries

The structural sizes currently achieved are diameters from 1 to 15 mm and heights of 0.2 to 4 mm. Local structural shaping can be combined with global forming by means of bending flat glass.

### Mold tools

Fraunhofer IWM has many years of experience in developing coatings of molds. Thus individually designed mold tool coating solutions are available to suit customers' specific needs. The stability and service life of such coatings can be tested at Fraunhofer IWM for their resistance to hot glass melts in an extended-time test.



Test specimen in contact with hot glass.