OMICS International
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Werner Karl Schomburg, J Material Sci Eng 2016, 5:2 (Suppl)
http://dx.doi.org/10.4172/2169-0022.C1.011

International Conference and Exhibition on
Materials Chemistry
March 31-April 01, 2016 Valencia, Spain

Ultrasonic fabrication of microfluidic polymer chips

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Ultrasonic fabrication is a new way to generate microfluidic chips. Micro channels are pro¬duced by ultrasonic hot embossing with a commercially available ultrasonic welding machine in a few seconds. A stack of polymer films is placed onto a tool with protruding micro structures. The stack is pressed onto the tool and ultrasonic vibrations generate friction heat and melt the polymer. The polymer adapts to the shape of the micro structures on the tool and har¬dens again by cooling down after the ultrasound is switched off. Then a single micro patterned piece of polymer is removed from the tool. A new tool can be fabricated by milling of an aluminum plate within a few hours. Therefore, this process requires both investment costs of a few 10,000 € and cycle times of a few seconds. Besides this, the fabrication can be changed to a new design or a new polymer in a few hours or a few minutes, respectively. Nearly every thermoplastic polymer can be processed this way.

By ultrasonic welding, micro channels generated by ultrasonic hot embossing are closed with a lid or another micro patterned layer. This way, chemical micro reactors, micro systems for bio¬logical investigations and analysis chips for disease diagnosis have been fabricated. Consider a polymer chip including micro structures for intercepting bubbles, a mixer and a cuvette. A cut is seen through the micro nozzle on a chemi¬cal micro reactor. The nozzle has a circular cross-section and was made of two ultra¬sonically hot embossed polymer layers welded on top of each other. Also there is a heat exchanger with three layers of micro channels on top of each other.

Biography

Werner Karl Schomburg obtained his Diploma in Theoretical Physics at the University of Kiel in 1983. In 1987 at the University of Munich he obtained his PhD in Experimental Nuclear Physics. He then was working for the LIGA process at Karlsruhe and became leader of a group developing low-cost micro fluidic devices from polymers. Since 2004 he has been the Head of a research group at RWTH Aachen University. His research interests are ultrasonic fabri¬ca¬tion of micro devices from thermoplastic polymers. From 2006 to 2009 he teaching for 3 weeks every year at Tsinghua University at Beijing. Recently, the 2nd edition of his book “Introduction to Microsystem Design” has been issued. He has published more than 220 scientific papers.

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