



3D Packaging of Medical Devices using Flip Chip on foldable Flex

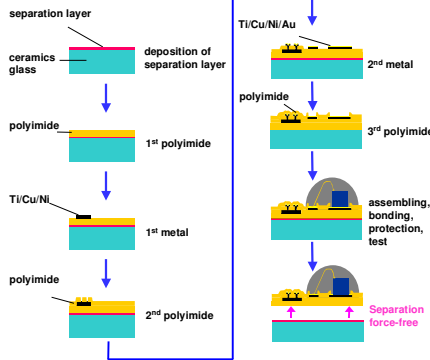
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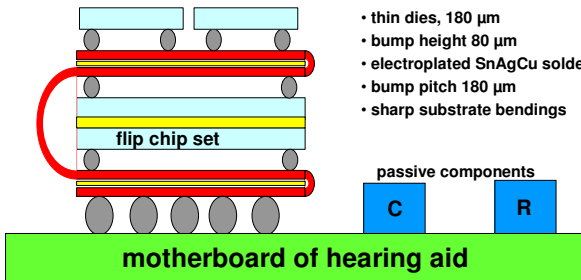
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Medical devices need a maximum of miniaturization for highest functionality in smallest volumes. With the HiCoFlex technology flexible multilayer circuits using the conventional thin film techniques are fabricated. Multilayers are build-up on temporary rigid carrier substrates by repetitive application of polyimide layers using a spin-on process and sputtering of metal layers which can be further enforced by galvanic deposition if needed. Folding of the substrates does not impede the electrical properties of the circuitry. The resulting 3D-packages have excellent mechanical and electrical properties. Application fields of such highly integrated modules are strongly growing areas like medical and health monitoring, both for implanted and non-implanted medical devices, sensors, portable and wearable electronic systems. A folded thin flex module containing a hearing aid flip-chip-set has been realised as a demonstrator.

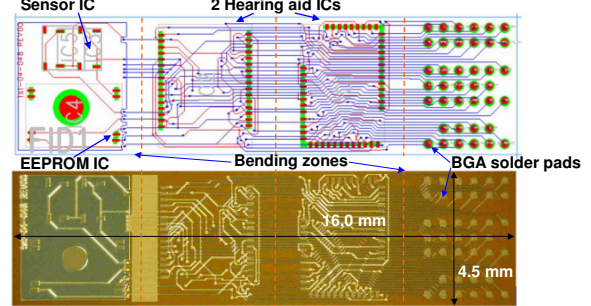
HiCoFlex® Process



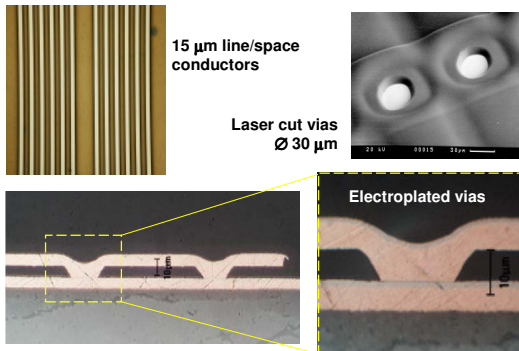
HiCoFlex® - Concept of Hearing Aid 'Flip Chip Set'



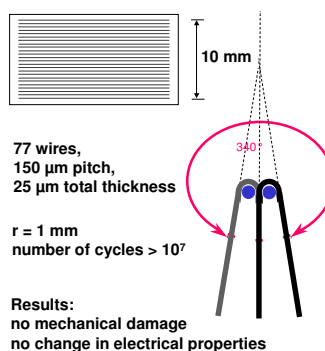
Hearing Aid Flip Chip Set Layout on HiCoFlex®



HiCoFlex® Resolution and Vias



HiCoFlex® Bending



HiCoFlex® Properties

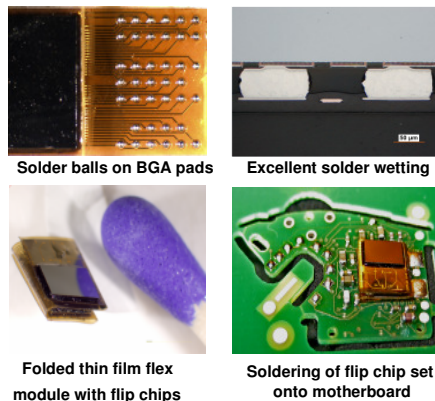
Properties	Value	Unit
dielectric constant (23 °C)	3.1	
dissipation factor (23 °C)	0.002	
coefficient of thermal expansion	3	ppm/K
thermal conductivity	0.4	W/mK
volume resistivity	1 x 10E16	Ohm cm
breakdown voltage	> 250	V/mm
glass transition temperature	> 400	°C
decomposition temperature	620	°C
weight (3-layer circuit)	8	mg/cm ²
water absorption (23 °C, 95% rel. humidity)	0.5	%
min. bending radius (3 layer circuit)	1	mm

HiCoFlex® Applications

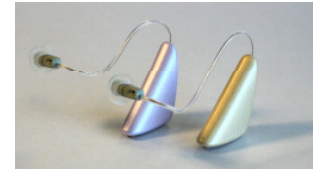
HiCoFlex multilayers are used in the fields of high-density interconnect (HDI) technologies for sensors, industrial and medical micro systems, thanks to:

- Ultra-thin, bendable flex boards used for , 3D packaging, e.g. for hearing aids, pill cams and other, miniaturized electronic applications,
- The integration of passive components, as thin film resistors, inductors and RF lines and structures,
- The resulting very thin and flexible multilayer foils which can be laminated into conventional rigid and flexible PCB as a local high-resolution part,
- Embedding of thinned active chips into HiCoFlex multilayers,
- Long Micro Cables (typical length >1.5m, width<100-200mm, 2-128 lines) for catheter connection, which are under study.

Assembly and Testing (TUB)



„Receiver In The Ear“ hearing aid (Oticon)



Conclusion and outlook

It has been shown, that extremely high routing densities on flexible substrates can be realized using the HiCoFlex technology. The portion of the electronic system with the highest functionality is thereby interconnected and further condensed by mechanical folding. The high density module can subsequently be connected a low density periphery like power supply or in the presented case to microphones and speakers. The future integration of passive components (resistors/capacitors) into the HiCoFlex substrate provides additional potential for miniaturization.

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