Ultra-Thin Microelectronics

- Developed under a CRADA between NSA and APL

Market Need

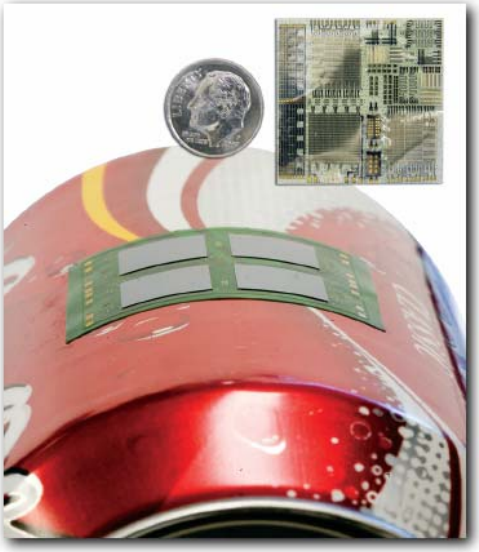
At one time electronics were relegated to only a few commercial industries, such as radio and television. This was primarily because electronics were large and expensive. Over the past 50 years, engineers have been able to shrink electronic components – allowing their beneficial incorporation into nearly all of today's products and serving as a market driver for new technologies.

The 1942 establishment of The Johns Hopkins University Applied Physics Laboratory (APL) was directly related to the push towards smaller, faster, more efficient and less expensive electronics. The very first APL researchers were asked to develop a method of packing a radar set into an artillery shell. They called the resulting new device a "proximity fuse" because it was capable of detonating near targets, rather than requiring direct hits.

Today, APL continues to lead the development of advanced microelectronics that drive advances in all high-tech industries including computer, sensor, fiber optic, telecommunication, military & aerospace, biomedical and transportation.

Features

Relying on established expertise and using new, innovative techniques, APL researchers have recently advanced their ability to develop thin, flexible microelectronic assemblies to a new limit. APL researchers can now produce these ultra-thin, flexible microelectronics assemblies with thicknesses of only 30 µm – 1/3 the thickness of a human hair.



The new, innovative processes for manufacturing these ultra-thin units were conceived in accordance with three objectives: reduce the thickness of the wiring substrates; reduce the integrated circuit die thickness; and reduce the thickness of the interconnect between chip and substrate.

Technology Status

Paper-thin assemblies were demonstrated and qualified by assembling thinned, bumped silicon die onto commercial flex wiring substrates. This process results in assembly yields in excess of 98% and is highly manufacturable because it uses traditional surface-mount flip-chip techniques and equipment. No specialized tools are required for this process.

Office of Technology Transfer

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Ultra-Thin Microelectronics

Innovative Processes Invented for Ultra-Thin Assemblies

- **Thin-Die**
can produce thinned die down to a thickness of 1 µm and routinely at the 5 to 10–µm level

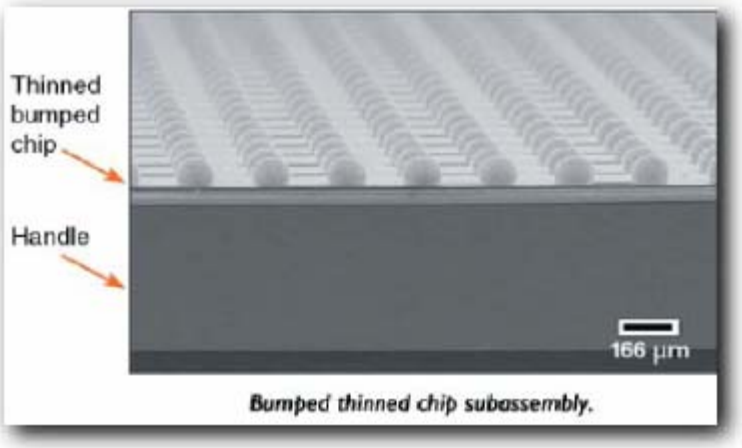
- **Thin-Substrate**
allows four-to-six conductor layers to be stacked in a space 12 to 18-µm high, while improving in plane wiring density by nearly an order of magnitude over commercial flex substrates

- **Interconnect**
four interconnect methods with unique advantages - depending upon the intended application and desired thickness - can be used to connect the thinned die to the thin substrates

Commercial Benefits

APL's ultra-thin microelectronic assemblies offer advantages in their ruggedness; lightweight and compact size; and low power consumption. In addition, the assemblies are conformable, such that they may be mounted or laminated to curved surfaces and serve in applications requiring assemblies of a non-standard form factor.

The exciting array of potential uses of APL's microelectronic assemblies includes smart cards; active circuit appliqués; highly miniaturized and implantable biomedical devices; incorporation of active circuitry into fabric (i.e. 'smart' fabrics); and application of active circuitry onto fixed curved surfaces. APL's researchers have also envisioned the use of these microelectronic assemblies for the fabrication of high-density applications and very thin 3-D modules. Specifically, qualified, preassembled thin flex-circuit layers may be stacked and laminated together, followed by the processing of vertical interconnections.



Bumped thinned chip subassembly.

Intellectual Property

U.S Patent Pending – 11/756816

Availability

This technology is currently available for licensing.

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