Advanced Cryogenic Testing Systems and Methods

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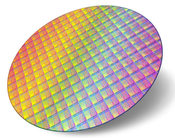
Innovation drives the demand for new technologies. Quantum computing, high-speed IR, photonics, space, and medical innovations generate demand to test semiconductor devices in cryogenic environments.

Why Cryogenic On-Wafer Test?

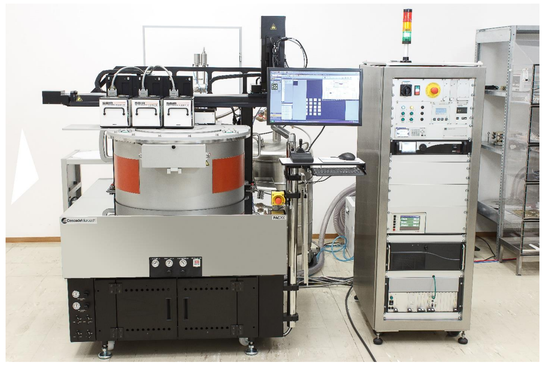
Cryogenic test requirement [4K, 77K common]

- Current technology and medical advancements are requiring the need for challenging cryogenic tests with higher throughput.



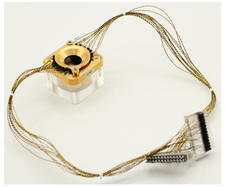
Hardware to *physically* handle DUT, Wafer, or Sample

- For optimal cryogenic test, a cryogenic **probe station** is used to **handle and thermalize** the DUT, Wafer, multiple-samples, or single die/chips.



Hardware to *electrically* test DUT, Wafer, or Sample

- To take electrical measurements, **probes and probe cards** are used to contact the DUT, Wafer, or Sample to transpose the signal into a larger environment to interface to test hardware.



Why a FFI and Celadon Cryogenic Partnership

Celadon Systems and FFI have partnered to provide a high-quality, fully integrated cryogenic test solution for these state-of-the-art devices. This complete and proven solution allows for on-wafer tests of these devices while maintaining the high standard of excellence of both companies' industry-leading products.

There are many factors and considerations, including thermal mass [mechanical support vs. time to temperature], material CTE's, ramp rates, signal integrity, all while maintaining high vacuum conditions at 10-4 to 10-5 mbar. With the FormFactor / Celadon partnership, customers will have access to a fully integrated Cryogenic Prober System and Cryogenic Probe Cards and Cables.

Celadon Cryogenic Probe Cards

Celadon is currently producing cryogenic probe cards for both production and lab environments. Celadon specializes in advanced and extreme probe test environments while demonstrating long life and repairability.

Form Factor Cryogenic Probe Station

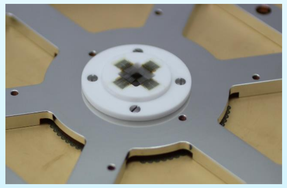
Wafer probers provide an established platform for performing electrical tests of integrated circuits at the wafer level.

The integrated solution shown to the left is on a semiautomatic cryogenic probe station with a high pin count probe card. A radiation shield covers the movable chuck of the station to establish conditions of 80K and below. The probe card is thermally anchored at cryogenic temperature to avoid additional heat load through the probe needles. With this, the radiative heat load on the cryogenic chuck and the DUT is minimized. Although these contacts are very soft, they are short in length and many.

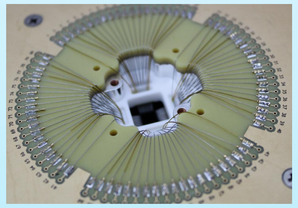
Probe Test Challenges and Celadon Solutions

Celadon specializes in advanced on wafer probing solutions. With success at temperatures down to **4K and below**, with extreme small **pad sizes [6x9µm],** Celadon produces probe solutions with capability far beyond that of anything available on the market.

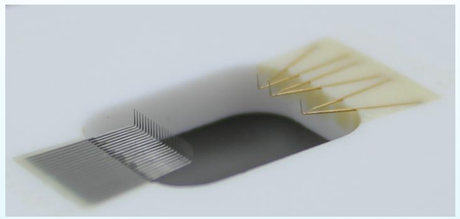
Thermal mass reduction for decreased chill time



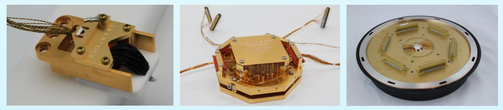
Non-magnetic requirements drive the need for unique interconnect



Some testing is in waffle packs driving the need for **extremely long probes for clearance** [1mm+]

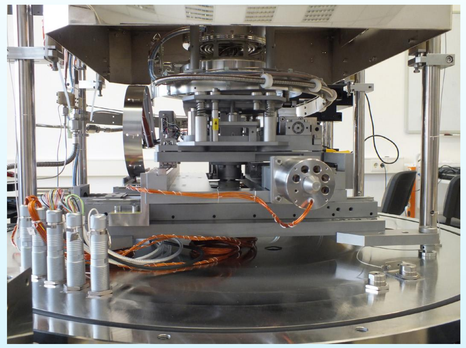


Different FFI Prober hardware and customer requirements drive the need for **different probe solutions**



Cryogenic shielded cabling required to maintain signal integrity at temperature

INTEGRATED SOLUTION



Cryogenic stage and radiation shield with an anti-reflecting surface towards the DUT

- LN_2 or LHe flow cryostat
- Separate cooling circuits for shield and chuck
- Precise temperature control ensures stability of 0.1 K or better
- Wide range of measurements (I-V, C-V, two-port, multi-port and differential RF)

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