High-end thermal solutions for wafer manufacturing process

In the semiconductor sector, machine-manufacturers at different stages of the wafer manufacturing process are looking for high-performing heating solutions that meet cutting-edge specifications in terms of design, uniformity, repeatability and lifetime but that are also able to withstand very corrosive environments under ultra-high vacuum and with ambient temperatures above 100°C.

THERMOCOAX's expertise is in responding to strict specifications and in designing tailor-made high-performing thermal solutions from mineral insulated cables.

Our engineering know-how, our prototyping capacity and our knowledge of mineral insulated cables allow us to offer unique solutions to our customers.

We are also able to develop complex mechanical parts that incorporate our heating elements.

Our strength is that we master all these processes internally with a factory certified "Copy exact" dedicated to SEMICON applications for **wafer manufacturing** processes: high precision machining, welding, soldering, tests and qualifications, control, ...

Over the last few months, THERMOCOAX has developed an innovative, reliable and efficient solution to heat a system inside a vacuum chamber.

The challenge of this project was combining two thermal systems that had to be integrated into the customer’s final system, in an ultra-high vacuum and corrosive environment at high temperature.

The first thermal system that we had to develop was a kind of heating element coiled on a mandrel

The solution was complex because we had to meet critical specifications such as:
• The limitations and dimensional tolerances of the heater
• Critical operating temperature of 800°C
• Achieving a 10% power distribution uniformity - Several heating areas have been designed with different power densities
• Operational guarantee > 5 years, in ultra-high vacuum with a corrosive environment

We designed 6 different concepts and compared these solutions in order to select one.

THERMOCOAX chose a design with EC wound / brazed on a metal support which was mass-produced in line with a specific process.

Progress achieved - results achieved - originality of the chosen solution

This design, which at first glance looks like a heating cartridge, is innovative in its design because it has a fully wound heating element integrated in a mandrel by a process developed by THERMOCOAX.

The expected performances and lifetime results were validated during the qualification phase of the prototypes.

This all-encompassing design by THERMOCOAX targets many areas, with its performance advantages, its low cost design and its long lifetime performance.

The second thermal system is a complex assembly of a 3D design metal part with high temperature heating elements

Problems to solve

Being able to assemble complex metallics with a demanding dimensional specification and an operating temperature that can reach up to 800-900°C.

This temperature is near critical, especially when specifying a lifetime greater than 5 years.

We had to resolve the problem of complex machining.

It was also necessary to take the deformations caused by the machining into account, as well as the deformation from the welding and brazing processes.

The design and manufacturing method was developed entirely by THERMOCOAX to achieve a feasible design suitable for high volume manufacturing and minimizing the risk of non-compliance with dimensional or functional specifications.

We worked on raw material (304L) and evaluated and selected the material that was the most cost / quality / time effective.
For the metallic parts we evaluated: Full mass / forged / foundry material.

The other challenge with these pieces was treating them on the surface so that the highly corrosive liquid in the vacuum chamber would not stick to them.

After much research and testing we identified a substance that has very good anti-wetting properties and could be used for this type of application.

Work has also been done to validate the most suitable deposition process (PVD or CVD).
We finally selected the best deposit solution that operates in up to 600°C.