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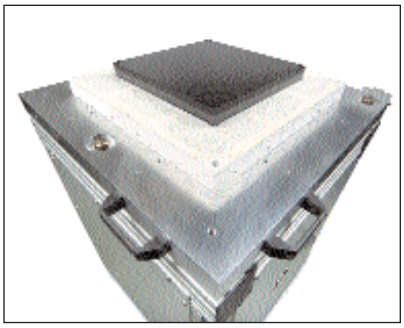
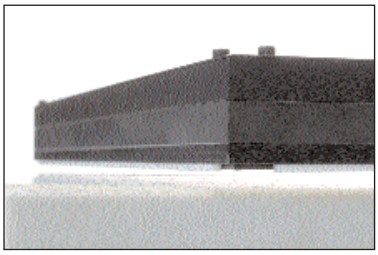
Philips Applied Technologies Demonstrates World's First Maglev Inverted Planar Technology

Philips Applied Technologies has released a unique planar magnetic levitation motion technology - called Planar Maglev - that features a completely free-floating platform with six degrees of freedom (or DoF1) while being unencumbered by the cables, cooling hoses and other mechanical connections typical of existing bearing-based approaches.





The announcement builds on Philips Applied Technologies' 2003 demonstration of a Linear (rather than Planar) Maglev technology that has since been developed into a commercial product ready for OEM delivery and use.

As with the previous Linear Maglev technologies in 2003, Philips Applied Technologies is introducing its Planar Maglev technology as a demonstrator to stimulate and aid discussions with potential partners regarding potential applications and prototype co-development.

The Planar Maglev technology uses an inverted mechanical design approach to apply motive forces to a moving platform via Lorentz force actuators2 that take the form of embedded permanent magnets on the platform and coils mounted on a stationary bed.

The Planar Maglev technology can achieve long-stroke linear displacements in the X and Y coordinate (of the order of 0.5 m) combined with short-stroke linear displacements in Z and rotational displacements in Rx, Ry and Rz (of the order of 1 mm). With the appropriate metrology (servo error tracking), Philips Applied Technologies confidently expects its Planar Maglev technology to be capable of achieving nanometer precision in ultra-high vacuum (UHV) and ultra-low contamination (ULC) applications. This is due to the self-contained nature of the technology and the way it supports highly reduced moving masses with no bulky, problematic cooling equipment and external interfaces.

One application is semiconductor wafer fabrication. The Planar Maglev technology's free-floating platform's "unlimited" X and Y strokes (restricted only by the dimensions of the stationary bed) will allow it to be applied to the transport of semiconductor wafers through a number of process steps without the need to transfer them to a another platform. The advantage would be that by limiting the number of times the wafer is handled, lithographic accuracy, processing time and ultimately yield would all be improved.

Philips Applied Technologies says that the complexity of any Planar Maglev implementation would be managed by what it calls "soft motion" software that has resulted from nearly a decade's work studying the dynamics of maglev systems. In operation, the soft motion software constructs a virtual model of the maglev system using data from the metrology system's sensors, effectively digitizing the mechatronics and then computes the forces required to move the platform to a new position.

It is by shifting the system's complexity into software that Philips Applied Technologies has been able to make the planar motor less mechanically complex than conventional multistage precision positional platforms, as well as less expensive for potential manufacturing partners to produce. In addition, the platform's relative simplicity makes it easier to design-in, and promises high robustness and low maintenance costs, thereby lowering the cost of ownership for customers.

"The soft motion software is the key enabler that allows both relatively simple mechanics to be used in the inverted planar design and maneuverability with six degrees of freedom to nanometer precision," said Peter Frissen, project leader for the inverted planar stage of the Planar Maglev technology. "That said, developing this software was no easy task and stems from years of close study of the dynamics of maglev systems channeled into the development of an ultra-efficient algorithm that could not be easily duplicated by others."

"These developments mean magnetic levitation now provides a technology that's mechanically simple and inexpensive to manufacture, clean, has no wearing parts and can be positioned with

accuracy down to tens of nanometers or less," said Dr. Ir. Jan van Eijk, a mechatronics expert and CTO at Philips Applied Technologies. "It's an essential development and will be the dominant factor in achieving the next level of accuracy in the field."

Philips Applied Technologies has been conducting research and pre-development on magnetic bearing and maglev positioning since the mid 1980s, with the objective of designing a practical, free-floating positional architecture as an alternative to stacked mechanical systems. While initial target applications are: optical and e-beam lithography and inspection, EUV lithography, and nano-imprint lithography; the technology will almost certainly be applicable to a wide range of other industries including laser machining, materials research, pharmaceutics, medical and food production.

Philips Applied Technologies will continue to specialize in the development of first-of-a-kind products for professional equipment and is actively seeking manufacturing partners to commercialize its maglev technology and products. "Maglev is ready for industrial use and is supported by a body of knowledge and a supply chain that is being further enhanced and expanded on a continuous basis," said van Eijk.

References used in release:

1. Degrees of freedom (DOF) is a commonly used science and engineering term that describes the number of ways in which a body or system can move. Any rigid body has at most six degrees of freedom: motion along any or all (Cartesian X-Y-Z) axes in three dimensions plus three uniquely recognizable forms of rotation - tilting up and down or "pitching" (Rz), swiveling left and right or "yawing" (Ry), and tilting side-to-side or "rolling" (Rx).
2. Detailed further information about Lorentz force actuators and how the Philips Applied Technologies Planar Maglev technology works is given in the accompanying technology backgrounder document.

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