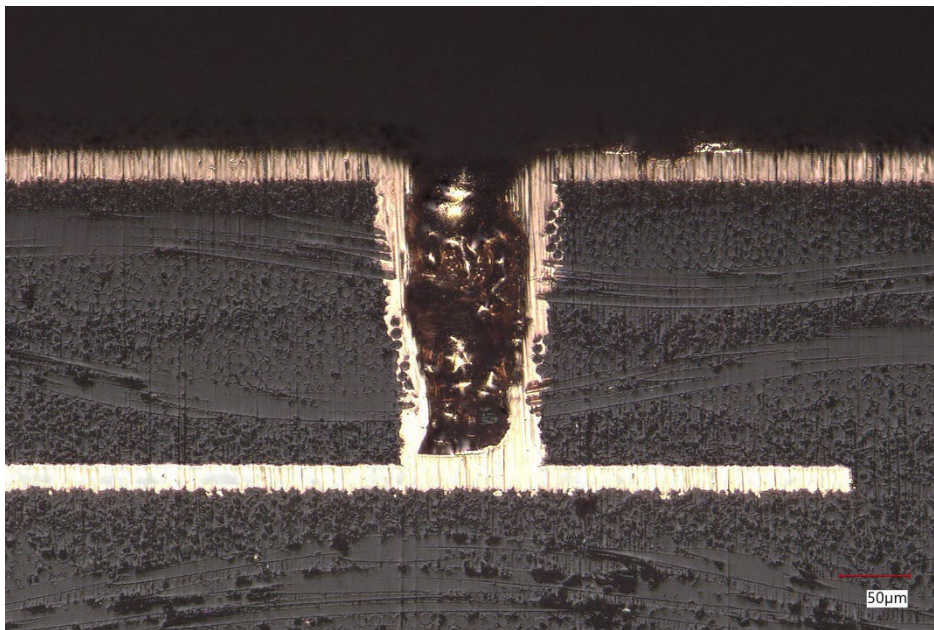


Elephantech Has Developed DeepVia™ HDI Solution for High-Aspect-Ratio Microvia Metallization

Enabling Very High AR $\geq 3:1$ to Advance AI computing

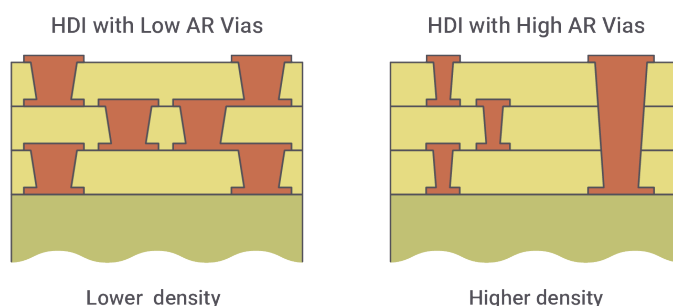
Elephantech Inc. announced the successful development of DeepVia™ HDI, a high-aspect-ratio microvia metallization solution based on its proprietary copper nanoparticle ink and inkjet printing equipment. This approach addresses the limitations of conventional metallization methods, enabling enhanced performance for AI server PCBs.



Cross-sectional view of metallized microvia
AR: 2.0, dielectric layer thickness: 200 μm, Φ : 100 μm

Background

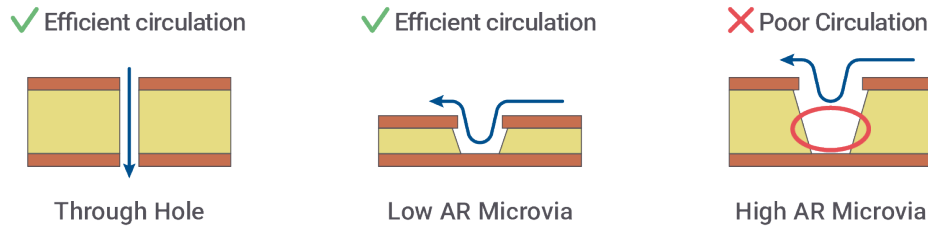
The rapid expansion of generative AI is driving demand for high-speed signal transmission and stable power supply at scale. As a result, AI server PCBs are evolving toward higher density and layer counts within limited form factors. Amid these trends, high-aspect-ratio vias are becoming essential to allow greater design flexibility and enhance system performance through efficient interconnection across deeper layers. However, conventional processes struggle to metallize such structures, limiting mass production capability. DeepVia™ HDI offers a novel solution to overcome the limitations and supports the realization of next-generation AI PCBs.



Challenges with Conventional Processes

In general, vias in boards are formed along the process flow of drilling – seed layer formation – copper electroplating. Forming seed-layer is typically achieved by electroless copper plating.

During electroless plating, the board is immersed in an aqueous solution containing copper ions and reducing agents. The chemical reaction between the two materials deposits copper on the via walls to form the seed-layer. However, as the aspect ratio of the microvias increases, diffusion of the materials down to the bottom of the via becomes more difficult, leading to insufficient deposition. Therefore high AR microvias often suffer from incomplete seed-layer formation, posing a significant challenge in achieving high-performance AI servers.

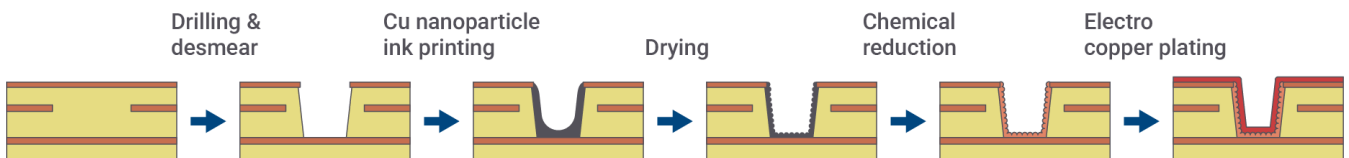


Impact of aspect ratio on solution circulation during microvia seed layer formation

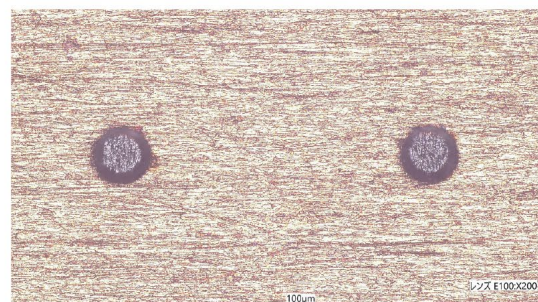
DeepVia™ HDI Process Overview

DeepVia™ HDI introduces a fundamentally different seed layer formation approach. Following drilling, copper nanoparticle ink is applied into the vias using inkjet printing. The ink, optimized for high AR via metallization, spontaneously spreads and wets via surfaces, enabling uniform coating of the inner walls. In the subsequent reduction step, the deposited copper nanoparticles coalesce to form a continuous copper layer.

While copper electroless plating can be regarded as a process where copper ions and reducing agents are supplied simultaneously and continuously through solution circulation, DeepVia™ HDI decouples their supply. By doing so, DeepVia™ HDI solves the problem that copper ions + reducing agents' reaction rate matches the rate of solution transport, leading to consumption before the materials can reach the lower area of the deep via, and enabling effective seed layer deposition in greater depth of the structure.



Before Cu nano inkjet printing

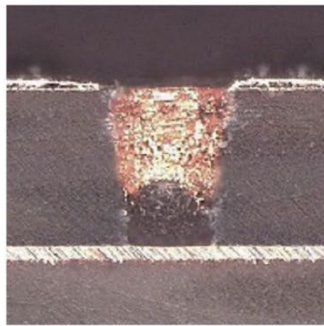


After Cu nano inkjet printing

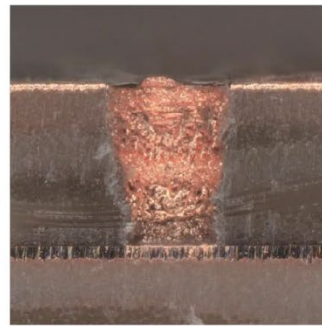
Performance Comparison

Approach	Max. aspect ratio range
Electroless copper plating (conventional)	1.0~1.2
DeepVia™ HDI	3~4

DeepVia™ HDI has demonstrated successful metallization of prototype microvias with very high aspect ratios ($AR \geq 3.0$), representing a significant advancement over conventional electroless copper plating, which is typically limited to $AR < 1.0$, with practical limits at around 1.2.



Insufficient seed formation



DeepVia™ seed formation

Comparison of seed layer formation prior to electroplating
 Φ : 100 μ m, AR: 2.0

DeepVia™ HDI has also been applied to coat extremely deep vias of 6 mm, effectively overcoming the aspect ratio constraints in the ink coating step. Although other process steps may still limit the full via fabrication, the primary challenge of inner wall coating has been eliminated.

Reliability test results

HDI specification

Φ (bottom): 0.1 mm, dielectric thickness: 0.2 mm, target plating thickness: 20 μ m.

Temperature: -55 °C (15 min.)/125 °C (15 min.)

Cycles: 100 (ongoing)

Criteria: resistance variation within $\pm 5\%$

Result: Pass

After the test, the change in resistance remained within criteria, and no abnormalities such as open circuits or cracks are observed, confirming stable interconnection reliability.



Elephantech

Key Technology: self-adsorbing copper nanoparticles and self-wetting ink

The breakthrough is built on the [HDI microvia formation technology](#) released by Elephantech last year. The key innovations enabling DeepVia™ HDI are self-adsorbing copper nanoparticles and self-wetting ink design. As aspect ratio increases, inkjet deposition of the ink alone becomes insufficient to achieve uniform coverage throughout the via, making control of ink transport necessary.

DeepVia™ HDI addresses this by specifically engineering a self-wetting ink that spontaneously spreads within the via. Through dynamic interactions with the prepreg surfaces, the copper nanoparticles sequentially adsorb and adhere onto the via walls, ensuring the ink's self-spreading behavior. As a result, a uniform coating is formed even in very high AR structures. By precisely controlling ink deposition volume, reliable via metallization can be achieved.

https://elephantech.com/cms/wp-content/uploads/2026/04/Wetting-Behavior-of-Cu-Nano-ink-01_260421.mp4

Outlook

Elephantech will provide the key components of this technology, copper nanoparticle ink NCT-05 for high AR vias and inkjet printing equipment DK series to PCB manufacturers. Several validation cases with leading manufacturers are underway, with equipment deliveries scheduled within this year.

Inquiries

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Company Overview

Name	Elephantech Inc.
Establishment	January 2014
Headquarters	4-3-8 Hatchobori, Chuo-ku, Tokyo 104-0032, Japan
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Business Description	Development, manufacturing, and sales of proprietary equipment and materials, and PCB products.
URL	https://elephantech.com/en/

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