

# Becoming the world's first mass producer of devices using thin-film bonding technology for dissimilar materials

The OKI Group became the first company in the world to successfully mass produce devices using "Epi Film Bonding" (EFB) technology, which will enable us to supply printers that meet market needs. EFB technology is expected to be applied in various ways, including to make printers significantly more compact and low power consumption.



A thin-film LED bonded to a driver IC using EFB technology

## Taking on the Challenge of Developing a Completely New Technology

OKI printers use a light-emitting diode (LED) mechanism. Light is emitted by a densely arranged LED array and dots are printed in places hit by the light. Compared to printers that use lasers and other mechanisms, this technology produces high resolution images and will help make printers faster and more compact. This unique technology has been lauded by many of our customers.

In recent years, however, the market has demanded that printers not only print faster and in higher resolutions but also be more resource efficient, compact and energy efficient. In order to meet these new requirements, it was necessary to create a completely new LED array that was not merely an extension of existing technology. The OKI Group's development team turned its focus to EFB technology, which bonds thin films with dissimilar materials, without the use of adhesives. We integrated light-emitting LED's, made from components differing from conventional print heads, with a driver IC to control them and became the first company in the world to successfully mass-produce a device for practical application.

## Smaller, More Energy Efficiency LED Print Heads

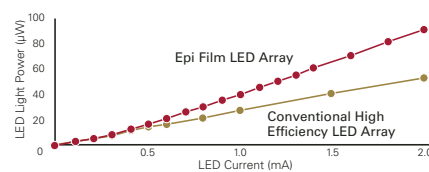
The LED print head we developed with EFB technology is half the volume of conventional print heads. We were able to substantially reduce the size of our C3400n color LED printer, the first product to feature the new print head, cutting its volume by some 64% compared to the previous model. Environmental impact at the production stage is also lower (Table 1), as there are fewer mounted chips and materials are maximized. Moreover, the light emitted from the LED's is utilized effectively, providing approximately twice the light of conventional models. This means less current is needed and less power is consumed (Diagram 1).

EFB technology makes it possible to create highly dense, highly integrated semiconductors, so it is expected to be used to make more compact, energy efficient integrated chips and to develop ultra-small LED displays. The OKI Group has started a research unit to work on these applications and intends to introduce EFB technology in many different areas.

Table 1: Comparison of Conventional LED Print Head and New LED Print Head

Environmental impact index	Conventional LED Head	New LED Head	Ratio
Compound semiconductor chip width	370µm	100µm	Approx. 1/4
Number of mounted chips	LED array chips: 26 Driver IC chips: 26 Total of 52 chips / A4	New chips: 26	1/2
Wire bonding number	3,664	650	Approx. 1/5
Wiring substrate width	10.8mm	7mm	Approx. 2/3
Print head volume	14×286×17mm =68,068mm <sup>2</sup>	10×286×11.5mm =32,890mm <sup>2</sup>	Approx 1/2

Diagram 1: Light Emitting Efficiency of Conventional LED and New LED



## Employee Perspective

In order to develop EFB technology, which was unexplored territory for us, we started by conducting basic experiments with the help of Hiroshima University and Nagoya Institute of Technology. We confirmed light emission from a bonded LED for the first time after half a year of work. I'll never forget the joy I felt when all 5,000 individual LED's within the print head lit up and a color printout was made. We plan to continue to develop EFB technology and pioneer new product areas.



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## Accolades for OKI's Epi Film Bonding Technology

Honorable Mention at the 4th Manufacturing Parts Awards sponsored by the Nikkan Kogyo Shimbun newspaper in March 2007  
Electronic/Information Appliance Division Award at the 2007 Nikkei BP Technology Awards sponsored by Nikkei BP in April 2007

\* Part of this research has been conducted by the Research Center for Nanodevices and Systems at Hiroshima University, which was supported by The Ministry of Education, Culture, Sports, Science and Technology's Nano Technology Support Project.