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Hitachi Chemical Company, Ltd.

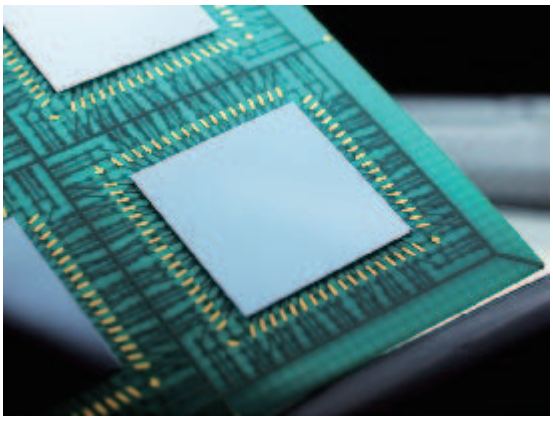
・R&D on Nanostructured Polymeric Materials / Developing High-performance Die Bonding (FY2001–FY2007)

Development of Die Bonding Film Contributes to High Performance in Electronic Devices

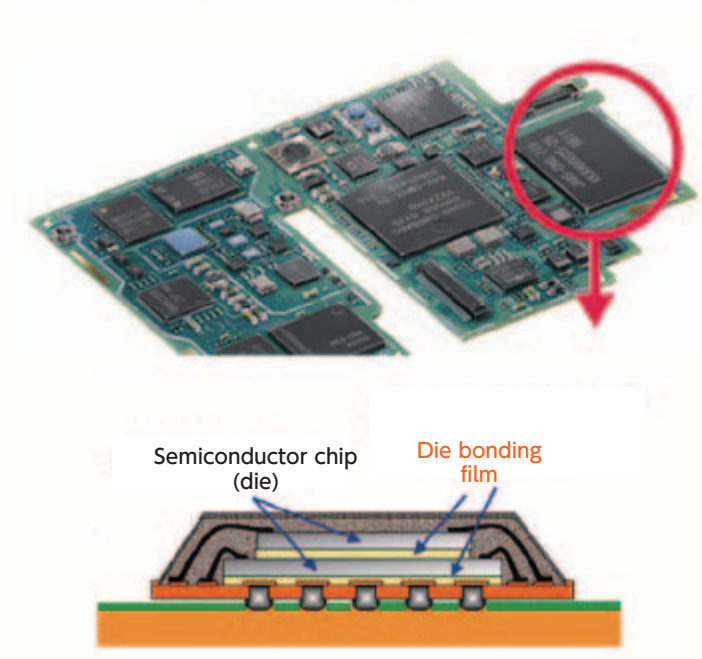
The high performance that has emerged in recent years in electronic devices such as mobile phones, smartphones, tablets, mobile music players, etc., is quite remarkable. Indispensable to these products are sophisticatedly integrated semiconductor packages. Semiconductors are composed of silicon layers called semiconductor chips, on which electronic circuits are embedded. The more layers of silicon, the greater the semiconductor memory.

Contributing extensively to the increase in lamination capabilities is an adhesive film called die bonding film, which enables multi-layer die stacking not achievable with conventional adhesives. This has led to remarkable progress in the development of compact large-capacity semiconductor memory. Through NEDO's R&D on Nanostructured Polymeric Materials project, Hitachi Chemical was among the first to successfully develop this die bonding film.

Today, Hitachi Chemical's die bonding film is used worldwide, boasting annual sales of 10 billion yen and currently accounting for more than half of the global die bonding market. Many electronic devices that we use on a daily basis owe their high-performance to Hitachi Chemical's die bonding film.



Semiconductor chip using a die bonding film



Cross-section of semiconductor package
Multiple semiconductor chips (dies) are laminated and secured using Hitachi Chemical's die bonding film.

Q. Why did this project start?

In response to market demands for more concentrated semiconductor packages, miniaturization technology that allows electronic circuits to be formed on semiconductor chips has continued to advance, then, density has been increased as far as possible, however, it is the physical limit of methods available for a single semiconductor chip, with economic factors being one of the reasons. One idea that is being developed today to enable even greater density is to stack semiconductor chips into a vertical arrangement. This project focused on development of a high-performance semiconductor adhesion film (die-bonding film) as one type of technology that supports stacking of semiconductors.

Q. What was the aim of the project?

Die-bonding film is one form of adhesive (die-bond) used to stick semiconductor chips together, and as the name implies, is a type of film. The manufacturing process of semiconductor packages is always subject to temperature changes, and after being released as a product, they are subject to various vibrations, including during use as well as transportation and dropping. To overcome this, die-bonding film needs to be resistant to heat and vibrations, in addition to functioning as an adhesive. The most important aspect while meeting these requirements was to develop a thin film that does not increase thickness even when stacked with multiple semiconductor chips.

Q. What is the role of NEDO?

While die-bonding film and other polymeric materials have excellent potential, the level of research and development difficulty is high, research takes a long time, and development costs are excessive. NEDO embarked on a project from FY2001 to advance polymeric materials, and proceeded with research and development of both the fundamental technology as well as technology for commercialization. Better ties with academia covering nano-scale observation technology helped to achieve a tremendous insight into the mechanism in the leadup to commercialization. In the die-bond field, high-performance adhesive films have previously been developed into products which provided an impetus for high density semiconductor packages and thus contributing to more compact and higher performance electronic devices.