

## PRESS RELEASE

April 12, 2016

Tanaka Precious Metals  
Tanaka Holdings Co., Ltd.  
S.E.I Co., Ltd.

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# TANAKA and S.E.I. Develop High-Power LED Modules Using AuRoFUSE™ Low-Temperature Bonding Material

By using AuRoFUSE™, heat dissipation and thermal expansion issues are resolved, enabling miniaturization and lower costs compared to existing products

Adoption in various applications is expected including LED illumination in harsh environments such as refrigerated warehouses as well as automotive illumination

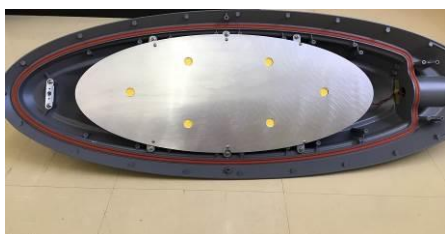
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Tanaka Kikinzoku Kogyo K.K.\*<sup>1</sup> (Head office: Chiyoda-ku, Tokyo; Representative Director & CEO: Akira Tanae) and S.E.I. Co., Ltd. (Head office: Hamada City, Shimane Prefecture; Representative Director: Makoto Saito) announced that they have developed LED (light-emitting diode) modules with higher power than existing products by using AuRoFUSE™\*<sup>2</sup> with sub-micron size (one-ten thousandth of a millimeter) gold particles as a low-temperature bonding material.

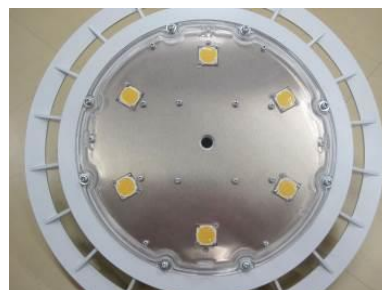
The new LED modules use AuRoFUSE™ as a bonding material to eliminate the wire bonding\*<sup>3</sup> that is currently the mainstream method and enable face-down bonding.\*<sup>4</sup> This improves electrical characteristics while maintaining high thermal dissipation and makes smaller modules possible. In addition, existing face-down structures\*<sup>5</sup> require the use of expensive aluminum nitride in the substrate, but by using AuRoFUSE™, direct bonding with a metal substrate is possible, reducing costs and making possible to manufacture more compact and higher-performance modules.

By introducing the new module into manufacturing and combining it with other products such as high-power projectors, it is expected that in the future a wide range of products can be developed including LED illumination for harsh environments such as refrigerated warehouses and automotive illumination.

### ■Examples of modules



Left: Streetlight (Wako Denken Co., Ltd.)



Center: Light projector  
(Wako Denken Co., Ltd.)



Right: Light projector (S.E.I. Co., Ltd.)

### ■Issues regarding LED modules

The power of LED lighting components steadily declines with rising temperatures caused by heat generation when the component is on. As a result, improving thermal dissipation is important issue in developing LED modules. When using the current mainstream method wire bonding, it is difficult for heat to escape outside the component since the LED light emitting surface is at the top, imposing a limit on thermal dissipation. Because of this reason, face-down bonding, which bonds the LED chip directly to the substrate, has attracted considerable attention.

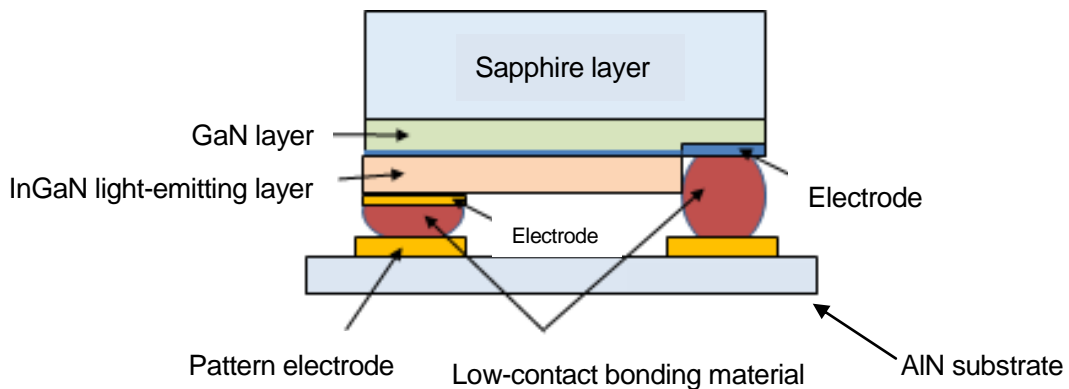
A face-down structure helps to release the heat to outside because the light-emitting surface is closer to the substrate. In addition, advantages of this structure are downsizing because of wiring space is not required and improving electrical characteristics because of wiring is eliminated. With a conventional bonding technology using AuSn solder, however, it is used on the substrate of expensive aluminum nitride which is difficult to shift to face-down structures in terms of cost.

### ■Benefits of this LED module

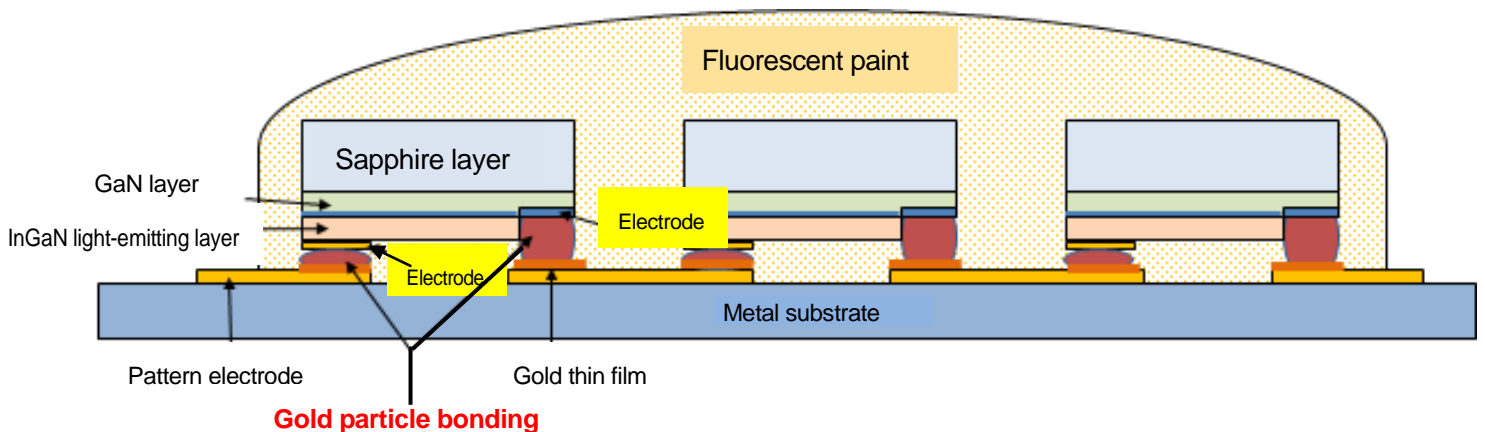
The new LED module adopts a face-down structure using AuRoFUSE™ as the bonding material, enabling direct bonding with the metal substrate. The difference in coefficients of thermal expansion between the LED chip and metal substrate is large, resulting in damage of conventional bonding. The gold particle bonding with AuRoFUSE™ has a function of stress release against thermal expansion mismatch, and consequently, the LED chip can successfully be bonded directly to the substrate.

The new LED module is proof against the environment temperature change, making possible to apply in refrigerated warehouse illumination during import and export. These compact LED modules also can enhance the designability of automobiles when used in automotive illumination. The new LED modules will expand the potential to manufacture diverse range of products that in the past entailed high development costs or were otherwise difficult to develop.

Explanatory diagrams of the new LED module and earlier products



Explanatory Diagram of Earlier LEDs



Explanatory Diagram of New LED Module

## ■Roles of Tanaka Precious Metals / S.E.I. and future development

Tanaka Precious Metals manufactured and provided the AuRoFUSE™ bonding material, while S.E.I. was responsible for manufacturing the module. As a result of this development, Tanaka Precious Metals will be able to give materials proposals to customers from a perspective that is closer to the final products.

\*1 Tanaka Kikinzoku Kogyo K.K., is a core company of Tanaka Holdings Co., Ltd. as a holding company.

\*2 AuRoFUSE™ is a paste-type bonding material containing a mixture of an organic solvent and gold particles with particle diameter controlled on the sub-micron size. Generally, microscopic particles exhibit a property known as "sintering" where particles bond to each other when heated to a temperature under the melting point. When AuRoFUSE™ is heated to 200°C, the solvent evaporates, and the gold particles undergo sinter bonding without the application of pressure. Sufficient bonding strength of approximately 30 megapascals (MPa) can be maintained at temperatures under 300°C. Bonding strength at high temperatures can be achieved without applying load onto components during bonding.

\*3 Wire bonding is a method of electrically bonding chips to lead frames or substrates. Wire bonding is currently the mainstream bonding technique since existing LED mounting technology can be used without modification.

\*4 Face-down bonding is a method of electrically bonding chips to lead frames or substrates using protruding electrodes (bumps). Chips with electrodes are turned over and bonded directly to the substrate.

\*5 A face-down structure is a substrate structure that uses face-down bonding.

■**Tanaka Holdings Co., Ltd. (Holding company of Tanaka Precious Metals)**

Headquarters: 22F, Tokyo Building, 2-7-3 Marunouchi, Chiyoda-ku, Tokyo

Representative: Akira Tanae, Representative Director & CEO

Founded: 1885

Incorporated: 1918

Capital: 500 million yen

Employees in consolidated group: 3,511 (FY2014)

Net sales of consolidated group: 856.4 billion yen (FY2014)

Main businesses of the group:

Strategic and efficient group management and management guidance to group companies as the holding company at the center of the Tanaka Precious Metals.

Website: <http://www.tanaka.co.jp/english> (Tanaka Precious Metals),

<http://pro.tanaka.co.jp/en> (Industrial products)

■**Tanaka Kikinzoku Kogyo K.K.**

Headquarters: 22F, Tokyo Building, 2-7-3 Marunouchi, Chiyoda-ku, Tokyo

Representative: Akira Tanae, Representative Director & CEO

Founded: 1885

Incorporated: 1918

Capital: 500 million yen

Employees: 1,992 (as of October 1, 2015)

Sales: 872,677 million yen (FY2014)

Main businesses:

Manufacture, sales, import and export of precious metals (platinum, gold, silver, and others) and various types of industrial precious metals products.

Website: <http://pro.tanaka.co.jp/en>

<About the Tanaka Precious Metals>

Established in 1885, the Tanaka Precious Metals has built a diversified range of business activities focused on the use of precious metals. On April 1, 2010, the group was reorganized with Tanaka Holdings Co., Ltd. as the holding company (parent company) of the Tanaka Precious Metals. In addition to strengthening corporate governance, the company aims to improve overall service to customers by ensuring efficient management and dynamic execution of operations. Tanaka Precious Metals is committed, as a specialist corporate entity, to providing a diverse range of products through cooperation among group companies.

Tanaka Precious Metals is in the top class in Japan in terms of the volume of precious metal handled, and for many years the group has developed and stably supplied industrial precious metals, in addition to providing accessories and savings commodities utilizing precious metals. As precious metal professionals, the group will continue to contribute to enriching people's lives in the future.

The five core companies in the Tanaka Precious Metals are as follows.

- Tanaka Holdings Co., Ltd. (pure holding company)
- Tanaka Kikinzoku Kogyo K.K.
- Tanaka Denshi Kogyo K.K.
- Electroplating Engineers of Japan, Limited
- Tanaka Kikinzoku Jewelry K.K.

■**S.E.I. Co., Ltd. (formerly Shimane Electronics Imafuku Works, CO., Ltd.)**

Headquarters: 281-1 Kanagi-cho Imafuku, Hamada City, Shimane Prefecture

Representative: Makoto Saito

Founded: 1978 Capital: 21 million yen

Employees: 32 (as of April 2016)

Sales: 300 million yen (FY2015)

Main businesses: Manufacture of device and development and manufacture of application products

Website: <http://www.s-imf.co.jp/>

<Press inquiries>

Tanaka Holdings Co., Ltd.

<https://www.tanaka.co.jp/en/protanaka/inquiry/index.php>