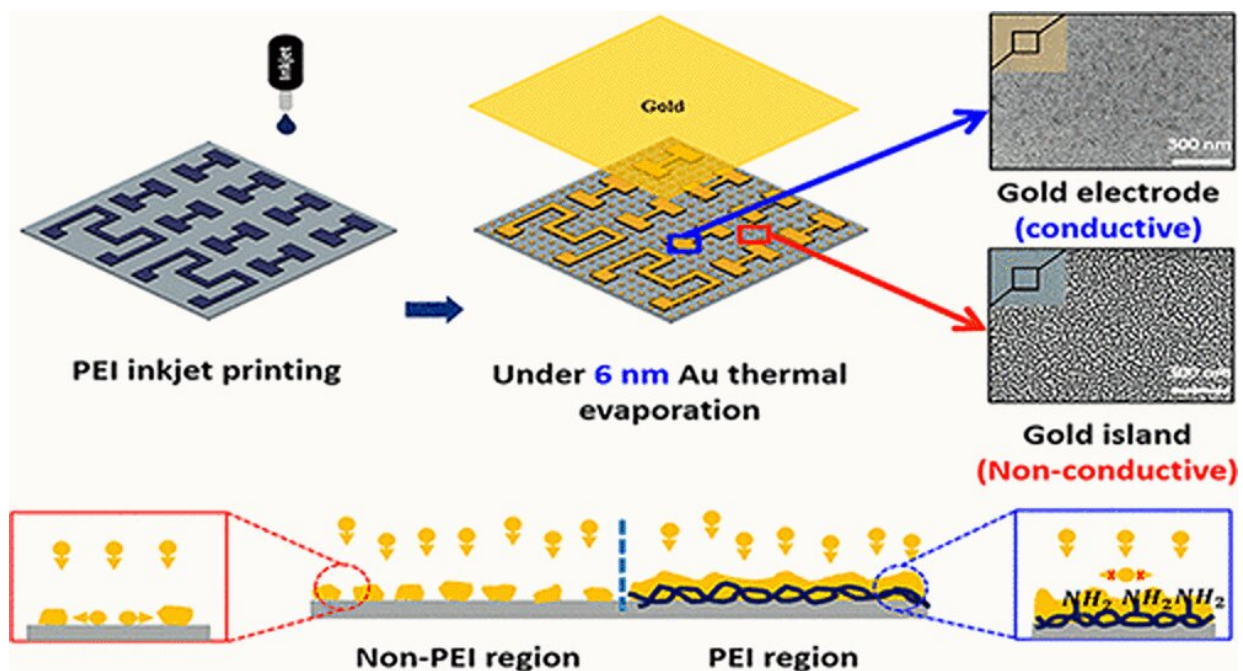


# A gold electrode fabrication technology that can be combined with thermotherapy technology based on phototherapy

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Graphical abstract. Credit: *ACS Applied Materials & Interfaces* (2023). DOI: 10.1021/acsami.3c01160

DGIST Professor Hongki Kang of the Department of Electrical Engineering & Computer Science and his research team successfully developed a selective photothermal layer formation technology and a transparent electrode based on the fine inkjet printing solution process.

This technology is anticipated to contribute to the development of biomaterial devices for applications that require device transparency or are sensitive to temperature changes.

Recently, there has been significant interest in a "transparent electrode" that facilitates bio-imaging and is applicable in various sectors, such as optogenetics. However, ink material used in existing transparent electrodes, such as [indium tin oxide](#) (ITO) or antimony tin oxide (ATO), require processing temperatures of 350 °C or above, which is higher than the transition temperature (150–200 °C) of flexible boards.

Therefore, using existing ink material to proceed with transparent electrode processing results in a mechanical weak point of the hardening of the flexible board due to the high temperature.

Thus, the research team used inkjet printing technology with a high degree of freedom in pattern formation to propose a new method of fabricating a transparent ultra-thin-film [gold](#) fine electrode customized for patients. Unlike the existing method of directly printing ink, this technology involves inkjet printing of a polymeric seed layer to induce ganglia generation, and "ultra-thin-film gold" of 6 nm or below is evaporated without a photomask to selectively process a transparent electrode with high penetrance.

Simultaneously, a "non-conducting gold island layer" is formed in the area where the polymeric seed layer is not printed, which can be implemented for phototherapy. The research team proceeded with verification to identify the completeness of the developed nanostructure. Phototherapy was detected using a transparent temperature sensor, and nerve cells were grown on the upper part of the device to identify both bio-suitability and potential for bio-imaging.

The "ultra-thin-film gold electrode and gold nanostructure" developed in

this study is advantageous compared to existing devices because processing is available at room temperature without using an exposure mask in the fields of engineering application and biomedicine where 'patient-customized flexible and wearable [transparent electrode formation](#)' is required.

The research team anticipates that an expansion of these technologies could lead to successful thermotherapy based on phototherapy, such as optics-based PCR, neuromodulation, cancer treatment, and drug delivery.

DGIST Professor Hongki Kang of the Department of Electrical Engineering & Computer Science stated that "the key is that this patient-customized 'ultra-thin-film gold electrode' can be produced using inkjet printing, which is different from the existing electrode formation method," and revealed that "it is anticipated that various body signals could be more efficiently measured using this technology through a patient-customized flexible fine [electrode](#) array."

The work is published in the journal *ACS Applied Materials & Interfaces*.

**More information:** Duhee Kim et al, Inkjet-Printed Polyelectrolyte Seed Layer-Based, Customizable, Transparent, Ultrathin Gold Electrodes and Facile Implementation of Photothermal Effect, *ACS Applied Materials & Interfaces* (2023). [DOI: 10.1021/acsami.3c01160](https://doi.org/10.1021/acsami.3c01160)

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