

High-Throughput Ejection of Microdroplets via a Femtosecond Laser-Addressable Nanomembrane Array

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Laser-induced forward transfer (LIFT) is a printing technique which employs a pulsed laser beam as a driving force to transfer material from a donor film to a receiving substrate. This process offers great advantages such as high efficiency, wide material compatibility and non-destructive printing, making it highly competitive among other printing technologies. LIFT technology has already been successfully used to print a variety of materials, including biological solutions, polymers, metals, and graphene, showing wide applications in electronic component manufacturing, sensors, and optoelectronic displays.[1-3] However, in liquid printing using LIFT, the droplet size is usually limited by the size of the incident laser spot, and the uniformity of droplet array is affected by the quality of the liquid film.

Herein, we propose a strategy to realize high-throughput ejection of microdroplets via a femtosecond laser-addressable nanomembrane array. A high-resolution nanomembrane array replaces conventional whole dynamically released layer (DRL) to first load microdroplets, and then these droplets are printed onto a receiving substrate using a low-energy femtosecond laser in high-throughput manner.

Figure 1 shows the schematic diagram the high-throughput transfer process of microdroplets. First, a photoresist pattern is fabricated on a glass substrate. A Ti layer is then deposited on this pattern using physical vapor deposition, followed by a lift-off to obtain a patterned Ti array. Next, using the as-prepared array as a mask, a photoresist array is left on the Ti array surface. After that, the substrate is fluorinated to form a wettability-contrast template. Finally, a uniform droplet array is pinned onto Ti islands by blade coating and can be transferred onto the receiving substrate, as shown in Figure 2. This method provides an efficient way to print high-resolution microdroplet arrays, with great potential for integrated devices, biosensors, and high-resolution optoelectronic devices.

Reference

- [1] P. Serra, A. Piqué, *Advanced Materials Technologies* 2019, 4, 1800099.
- [2] N. Nedyalkov, A. Dikovska, T. Dilova, G. Atanasova, R. Andreeva, G. Avdeev, *Materials* 2026, 19, 176.
- [3] M. Morales, D. Munoz-Martin, A. Marquez, S. Lauzurica, C. Molpeceres, *Advances in laser materials processing* 2018, 339.

Figures:

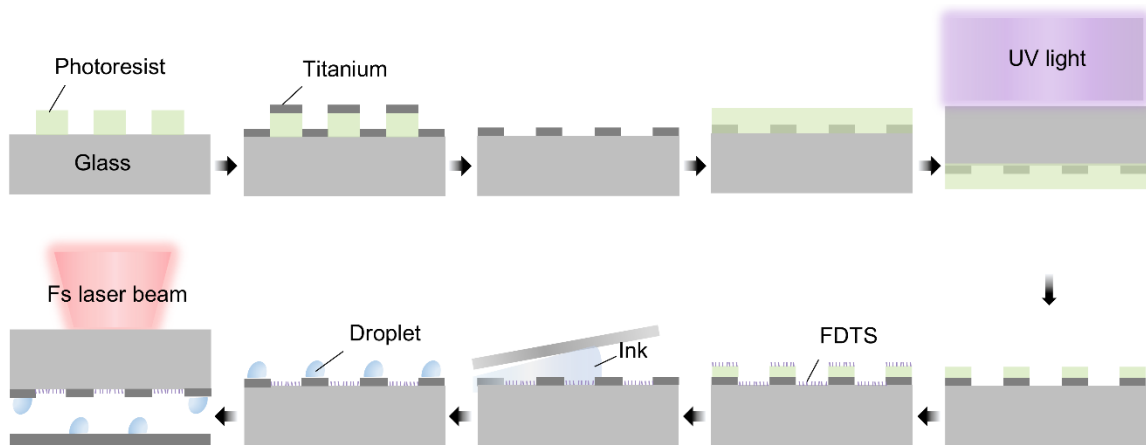


Figure 1: Schematics of high-throughput ejection of microdroplets.

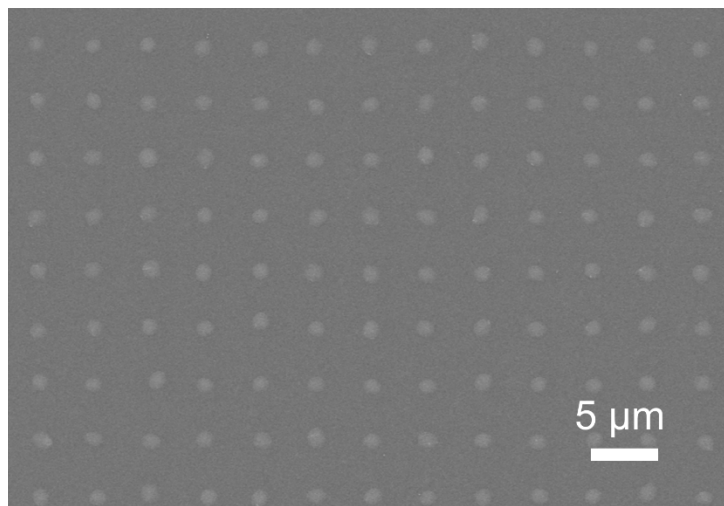


Figure 2: SEM image of a printed microdroplet array.