# On-Demand Deposition of Gold Nanodots by Laser-Induced Dot Transfer

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## 1. Introduction

Size and site-controlled metallic nanodot formation has good potential in the fields of plasmonics and nanophotonics, such as ultrasensitive surface-enhanced Raman scattering detection and metamaterials [1]. So far, we have demonstrated on-demand fabrication of dots with a diameter of 500 nm to a few micrometers by laser-induced transfer with one-to-one dot deposition and sub-spot resolution, which is referred to *laser-induced dot transfer* (LIDT) [2,3]. In LIDT, a single laser pulse is tightly focused onto a source film, which is on a supporting transparent plate, and site-controlled deposition of a single melt droplet onto a receiver substrate placed behind the film occurs. The droplets have much smaller lateral dimensions than the laser focal area. The LIDT is advantageous in that it has higher resolutions than commercially available inkjet techniques and there is an availability of solvent-free source materials. In this work, we report on-demand deposition of gold nanodots by the LIDT.

## 2. Experimental

The fourth harmonic of an Nd:$YVO_4$ DPSS laser ($\lambda$ = 266 nm, fwhm 30 ns, frequency up to 100 kHz, $M^2 < 1.3$) was used as the light source. Laser pulses were scanned with a galvanometer-based point-scanning module, as shown in Fig. 1. A single pulse was focused at the interface between a transparent support and a 100 nm-thick gold source film. An ozone-cleaned silica glass substrate was placed behind the gold film in nearly-contact state. The surface morphologies of the film and deposited structures were observed with a confocal scanning laser microscope.

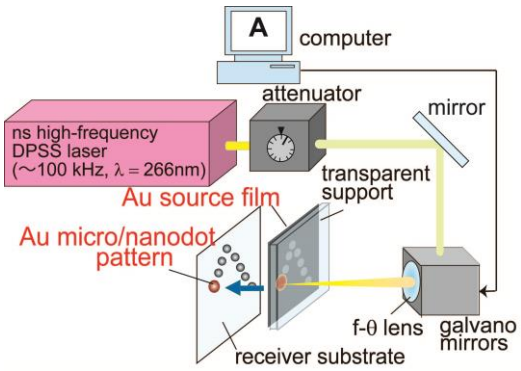


Fig.1 Typical setup for laser-induced dot transfer (LIDT).

## 3. On-demand formation of gold nanodots

Figure 2 (a) shows the dependence of the surface morphology of gold source films on the laser pulse energy. At a pulse energy of 0.15 μJ, the gold source film began to make a small bump with a height of about 300 nm (nano-bump), but there was no transfer onto a receiver substrate. At higher energies, the single-pulse irradiation made a hole at the gold film surface, resulting in material transfer onto the substrate. At 0.20 μJ, a single gold dot was transferred from a single laser spot onto the substrate without position precision. At an optimum energy of 0.29 μJ, the site-controlled deposition of a dot with a diameter of about 500 nm was observed on the receiver substrate, as shown in Fig. 2(b). At 0.74 μJ, the deposition of multiple dots occurred from a laser spot under the single pulse irradiation, as shown in Fig. 2 (c). In this case, it became difficult to realize site- and size-controlled dot formation. Therefore, the on-demand preparation of gold nanodots can be achieved by the LIDT process at the optimum pulse energy.

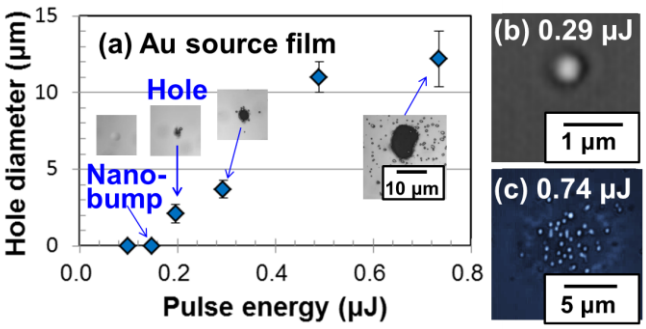


Fig.2 (a) Dependence of surface morphology of gold source films on laser pulse energy. (b-c) Confocal scanning laser microscopic images of transferred dots at (b) 0.29 and (c) 0.74 μJ, respectively.

## 4. Conclusion

We have developed site-controlled additive formation of gold nanodots with a diameter of about 500 nm by the LIDT under atmospheric and room-temperature condition.

## Acknowledgement

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## References

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