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Flexible organic light-emitting diodes using laser lift-off method

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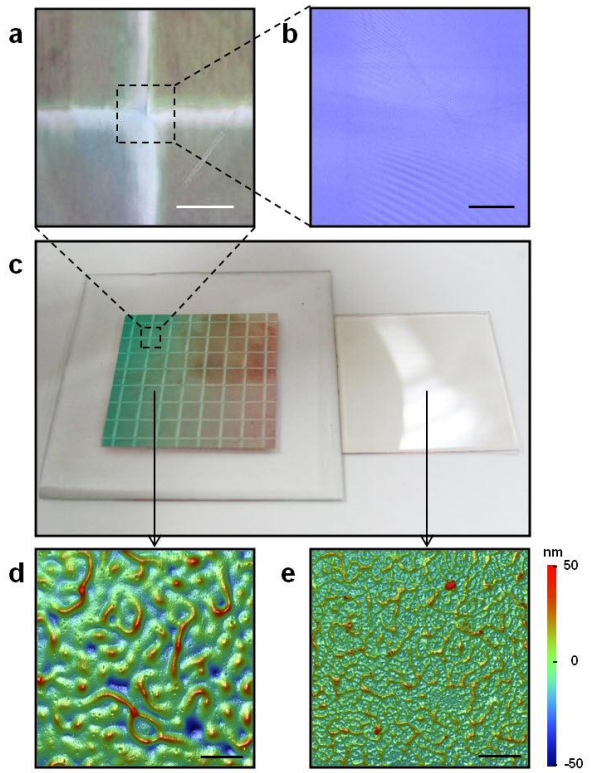

Fig, S1 AFM and SEM images before and after laser-off process. a, Optical microscopy image of surface morphology on GaO_x film after laser lift-off. Scale bar, 1 mm. **b,** SEM images. No cracks or damage occurred after two KrF excimer laser irradiations. A moiré pattern formed where the irradiated areas overlapped. Scale bar, 100 μm. **c,** A separated OLED sample (3 × 3 cm) and a carrier glass after laser lift-off. **d**, AFM phase image of the lower side of the device and **e**, the separated glass substrate after laser lift-off process. The average surface roughness was small (~0.7 nm) before laser lift-off, but increased to ~8.5 nm after lift-off. The sacrificial GaO_x film was completely melted and separated without cracks by absorbing laser energy. AFM image size was fixed to be 5 μm × 5 μm. Scale bar, 1 μm

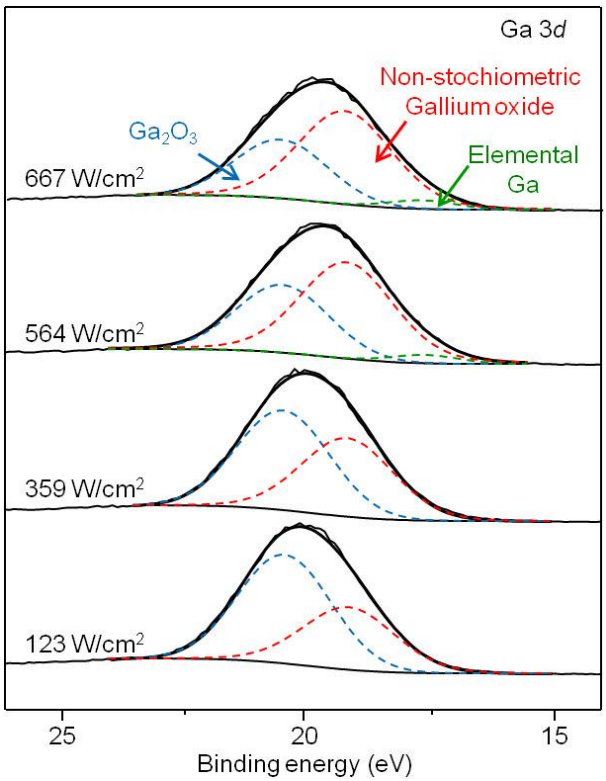

Fig. S2. SRPES spectra of Ga $3d_{5/2}$ of GaO_x. Ga $3d_{5/2}$ SRPES spectra of as-prepared GaO_x film as a function of P_E and of laser irradiated GaO_x film under OLED. The Ga_2O component was rarely formed in special reduction ambient[1]. $2Ga_2O_3 \rightarrow Ga_2O + 2Ga + O_2$. As P_E increased from 123 W/cm^2 to 893 W/cm^2, the intensity ratio of Ga_2O to Ga_2O_3 increased from 0.28 to 0.67 and the full width at half maximum of GaO_x samples expanded from 2.72 eV to 2.92 eV. A new Ga component was observed at P_E = 667 W/cm^2 and the intensity of this component increased I_D.

References

1. R. Carli and C. L. Bianchi, *Appl. Surf. Sci*., 1994, **74**, 99-102.