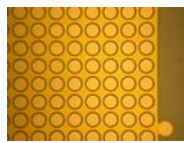


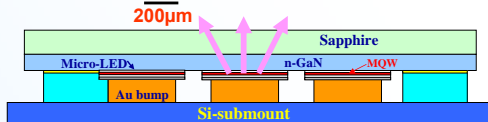
Individually-addressable flip-chip micro-LED arrays with integrated micro-lenses

Abstract: 16x16 micropixelated flip-chip LED arrays (100–250 pixel/mm²) were designed and fabricated on LED wafers grown on a sapphire substrate. Each micro-LED pixel has a diameter of 72 μm on a 100μm pitch. The emitting wavelength of the micro-disk LEDs ranges from 470 nm (blue) to 370 nm (UV). Special n common contact has been constructed in the devices so as to ensure uniform current injection and consequently uniform light emission. Due to the light extraction enhancement and of a better thermal management, the flip-chip LED pixel shows a higher output power density compared to a standard broad area LED. Finally, in order to manipulate the output light beam (collimation or focalization), sapphire or polymer lens arrays have been successfully integrated with the micro-LED array. These flip-chip micro-LED arrays have a wide range of applications including mask-free lithography, biomedical sensors, polymer laser pumping and micro-color displays.

Introduction of the flip chip micro-LEDs arrays

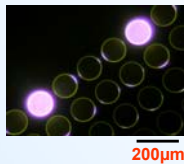
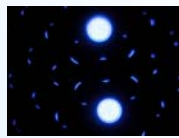


Chip size : 7 x 7 mm
 16 x 16 micro-array elements
 Each pixel: 72 μm in diameter
 Centre-to-centre: 100 μm

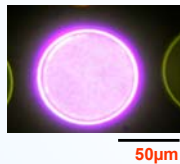
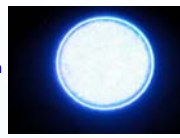


Light emitting through sapphire substrate

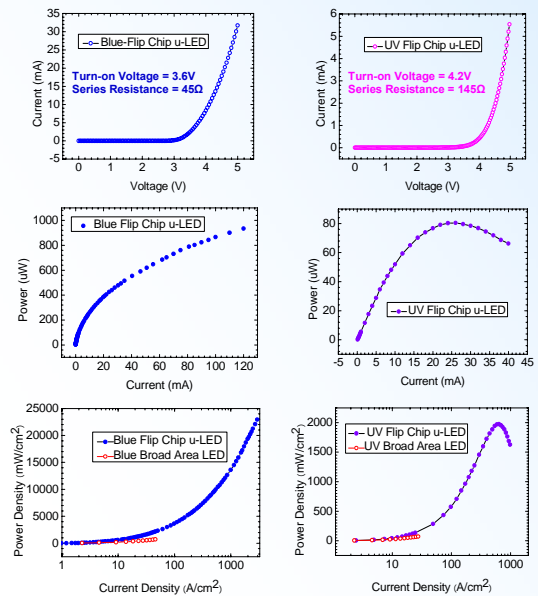
Two elements ON



One element ON



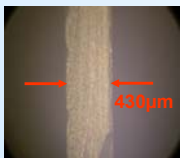
II-V characterization and output power measurements



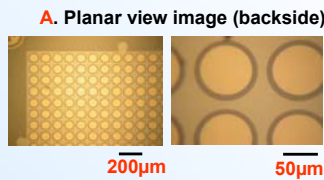
⇒ The flip-chip devices show a higher light output power density due to the improvement of both the light extraction and the thermal management

Flip chip μ-LED arrays-thinning an polishing

Before Thinning and Polishing

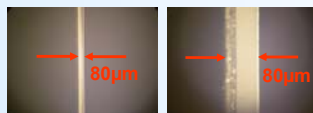


After Thinning and Polishing



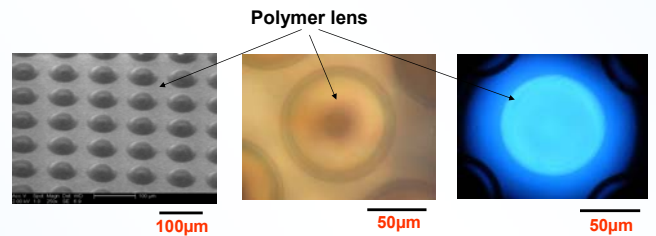
- Before thinning and polishing: original Thickness = 430μm
- After thinning and polishing: Surface Roughness < 10nm Final Thickness = 80μm

B. Cross section image

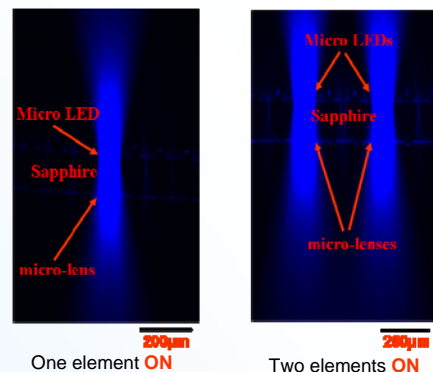


Micro-lens integration

Two steps process: resist reflow technique + shape transfer by dry etching



Confocal microscopy results



Perspectives

- ◆ Increasing the pixel density: design and fabrication of 32x32 flip-chip μ-LED arrays (~5100 pixel/mm²).
- ◆ Developing of μ-LED arrays with deep UV emission (< 300nm).
- ◆ Optimization of the μ-LED device for different applications.