

Deep UV-transparent and Light Emitting Polymers integrated on AllnGaN Light Emitting Devices



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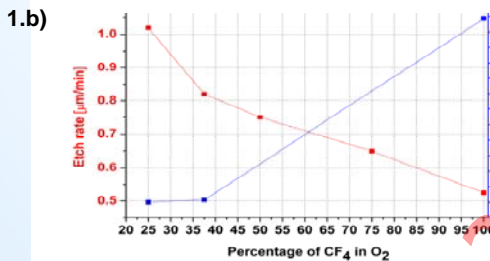
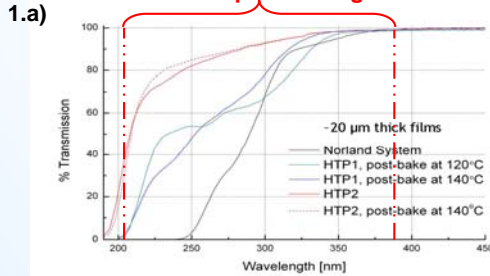
Abstract

The study of the physical properties and processability of novel polymers to project the light from micro-pixelated UV LED sources is presented here. Polymer micro-lens fabrication and integration on a micro-structured LED array device is the key issue to achieve directional output beams since it has been demonstrated these emitters have a beam divergence of 70° full-angle [1] and [2]. UV colour down-conversion [3] is also possible in a pixel format by the use of Light Emitting Polymers integrated on a micro-structured device with a UV-transparent polymer interlayer.

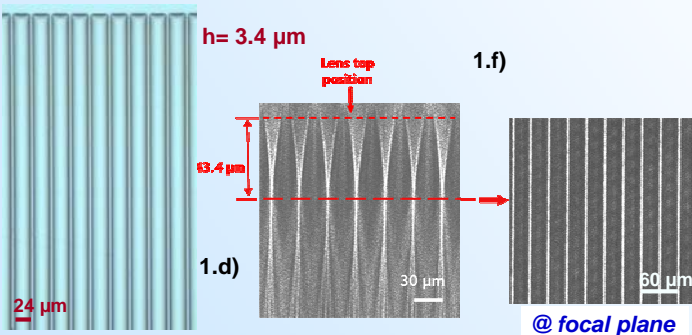
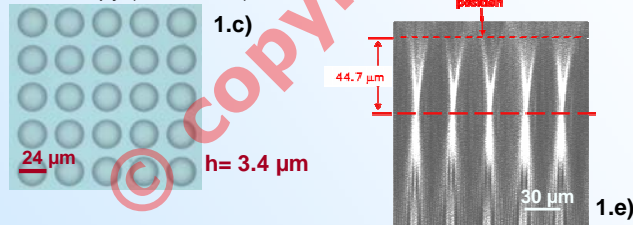
Deep UV-transparent polymer for micro-optics fabrication:

Transmission spectra (1.a) and process characteristics (1.b) of deep UV-transparent polymers developed by the Strathclyde Chemistry department. The transmission characteristics offer an 80% transmission down to 230 nm with an RMS roughness of 2.5 nm over a 5x5 μm² area.

AllnGaN LED spectral range of 210 nm to 370 nm

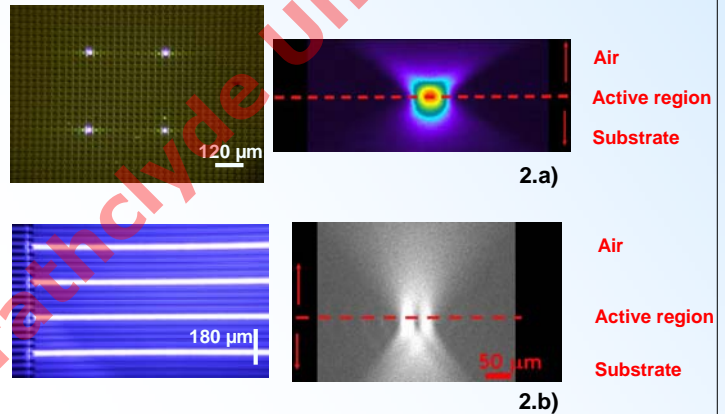


A micro-optics array has been fabricated using photolithography, photoresist reflow and conventional RIE O₂/CF₄ plasma. Figures on the left show microscope images of spherical and cylindrical microlenses (respectively 1.c and 1.d). The right-hand side pictures show the functionality of the polymer microlenses using confocal microscopy (1.e and 1.f).



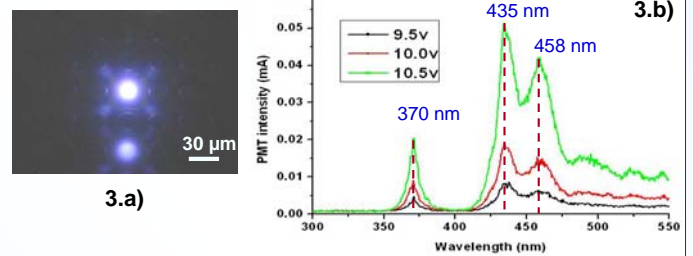
Micro-structured matrix addressable (64x64) and individually addressed LED array:

Micro-pixelated LED in disk (2.a) and stripe format (2.b). The confocal microscopy beam divergence measurements give respectively 32° and 35° half-angle divergence.

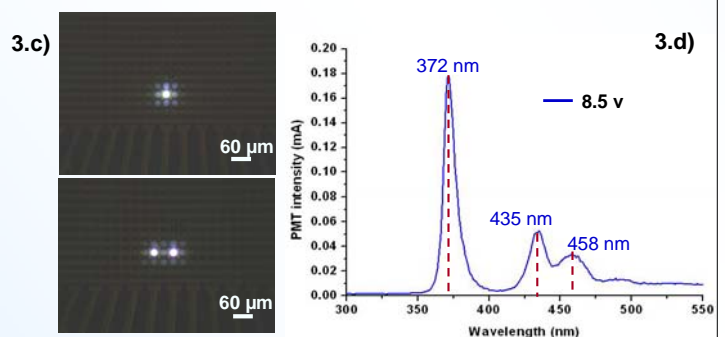


UV light down-conversion in a pixelated format:

The integration of light emitting polymer has been done in two steps. The top pictures show a bare film of LEP spin coated on top of the μ-UV emitters on an HTP2 interlayer excited with 2 μ-emitters (3.a). The emission spectra is given for different driving voltages (3.b).



The following pictures are a pixelated format of LEP integration with encapsulation comprising the structure HTP2/LEP/NOA63. The pictures show one and two pixels LEP pumping (3.c) and the corresponding spectra (3.d).



References:

- [1] Beam divergence measurements of InGaN/GaN micro-array LEDs using confocal microscopy, C.Griffin et al, Appl. Phys. Lett., 2004
- [2] Microstripe array InGaN LEDs with individually-addressable elements, H.X. Zhang et al, IEEE Photon. Tech. Lett., accepted, 2006
- [3] Wavelength-tunable and white-light emission from polymer-converted pixelated InGaN UV LEDs, G. Heliotis et al, Pure. Appl. Opt., vol 8, 2006