



Fig. 5. (a)-(d) Measured angle resolved normalized spectral emission of the same luminous areas. The 35 nm grating device without (a) and with (b) the microlens array and the 15 nm grating device without (c) and with (d) the microlens array.

Furthermore, the microlens arrays reduce the total internal reflection at the substrate/air interface as described above. We emphasize, that all measurements have been performed on the very same devices. After measuring the devices with the microlens arrays we removed the arrays by simply peeling them off and performed the measurement again.

4. Conclusion

In conclusion we have presented a method to optimize the outcoupling efficiency and viewing angle of WOLEDs. By adding a high index Bragg-grating consisting of TiO_2 into the WOLED stack and adjusting the grating height we were able to achieve an overall efficiency enhancement of up to 104%. By adding a high quality microlens array we were able to enhance the efficiency of the already improved devices by another 94%, leading to an overall enhancement factor of ~ 4 . Furthermore, the microlens array diffuses the emitted light, leading to a uniform white emission with no angular or spectral dependencies.

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