**Enhanced performance of organic light-emitting devices by integrating microstructure**

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**Abstract**

The waveguide and surface plasmon-polariton (SPP) modes that were generally lost in conventional bottom-emitting organic light-emitting devices (BOLEDs) have been successfully recovered by employing a microstructure, and a much enhanced light extraction has been observed. We demonstrate that the introduction of a periodic corrugation into the top-emitting OLEDs (TOLEDs) is effective in relieving the tradeoff between device lifetime and efficiency, through the coupling of the SPPs associated with the Ag cathode and the microcavity modes. Moreover, the viewing characteristics of TOLEDs have been improved by employing microstructure to construct a microcavity with periodically changed cavity length.

**Keyword:** organic light-emitting devices, light extraction, microstructure

1. INTRODUCTION

Microstructure with wavelength to subwavelength-scale periodicity has played an important role in optical and optoelectronic devices, particularly in optical fibers, distributed feedback lasers, LEDs and solar cells etc. through manipulating the generation and propagation of photons in materials. We have performed systematic investigations on the fabrication of microstructure in organic light-emitting devices (OLEDs) and their effects on improving the device performance.

2. EXPERIMENTAL AND RESULTS

A periodic wavelength-scale corrugation has been introduced into OLEDs by one-step laser ablation of two interference beams (Fig. 1), and enhanced outcoupling of radiation has been demonstrated (Fig. 2). The introduction of this microstructure has allowed the observation of the emission originating from the SPP and WG modes, which are usually trapped within planar devices. An enhanced EL efficiency from the corrugated OLEDs has been observed. The microstructure has been directly formed on the HTL of the OLEDs by laser ablation without degradation of the device performance.

The efficiency-stability tradeoff existed in the TOLEDs has been effectively released by employing a periodic microstructure in the device (Fig. 3). The introduction of the periodic corrugation has allowed a much enhanced light transmission through a thick Ag cathode through the grating-induced cross coupling between the SPPs associated with top interface of the cathode and microcavity modes within the device cavity. An enhancement in both EL efficiency and device stability has been observed.

![Fig. 1 Scheme of introducing periodic corrugation into OLEDs.](image)

![Fig. 2 EL enhancement of the corrugated OLEDs compared to that of the planer devices.](image)

We demonstrate optimized viewing-angle characteristics from top-emitting organic light-emitting devices by integrating a periodic microstructure into the cavity (Fig. 4). A holographic lithography technique combined with filling process of the groove by spin coating of a polymer film has

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been employed to enable its periodically and gradually changed cavity length and suppress the viewing-angle dependence of the peak emission wavelength and intensity. The theoretical and experimental results support that the proposed microstructured cavity can resolve the angular-dependence effect in a very simple and effective way, and a desired omnidirectional emission has been obtained.

3. SUMMARY

Microstructure has been successfully applied into OLEDs and exhibited its role in recovering the power lost in SPP and WG modes, solving efficiency-stability tradeoff in TOLEDs and improving the viewing characteristics.

4. REFERENCES

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