SPONTANEOUS BUCKLED STRUCTURE FOR ENHANCING OUTCOUPLED ORGANIC ELECTROLUMINESCENCE

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Most of the light in conventional organic light emitting diodes (OLEDs) is confined to high refractive index layers such as an organic medium, ITO, and a glass substrate, resulting in a low light extraction efficiency of about 20%. We fabricate a buckling structure by thermally depositing aluminum on a polymer surface and cooling it to room temperature. In order to enhance outcoupled organic electroluminescence, we utilized this structure as (1) a periodic structure and (2) a microlens aggregate. The buckling structure is characterized by broad periodicity distribution and randomly oriented wave vectors of buckles. This characteristic structure provides the following invaluable advantages in OLED devices.

(1) Enhanced outcoupling: Many studies have used wavelength-scale periodic gratings to increase the external efficiency of OLEDs. However, the efficiency is only enhanced at particular wavelengths satisfying the Bragg condition. We demonstrate that a quasi-periodic buckling structure with broad distribution and directional randomness can enhance the light extraction efficiency without introducing spectral changes and directionality. OLEDs with buckles showed improved current and power efficiencies and an enhanced EL spectrum at least by 2 times over all wavelengths.

(2) Improved emission characteristics: We demonstrate that the characteristics of the outcoupled emission of this device are improved from various perspectives such as efficiency, emission angle, and reduced spectral change. These improved characteristics originate from randomized double-curvatured lens structure with full surface coverage.

[1] W. H. Koo, S. M. Jeong, F. Araoka, K. Ishikawa, S. Nishimura, T. Toyooka, H. Takezoe, Nature Photonics, **4** (2010) 222.
[2] W. H. Koo, H. J. Yun, F. Araoka, K. Ishikawa, S. M. Jeong, S. Nishimura, T. Toyooka, and H. Takezoe, Appl. Phys. Exp. **3** (2010) 082501.