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Organic LED

We developed a new general blade coating method for organic semiconductors. Its features include multi-layer deposition without dissolution, large area, as well as high material usage. It is therefore a platform to make high-performance organic semiconductor devices and products at low cost. In solid-state lighting the inorganic light emitting diode (LED) in combination with optical diffuser has entering the market. LED is however by itself a point light source and the diffuser makes the lighting panel bulking and expensive. More importantly, the short-wavelength blue emission from the LED causes unnatural feeling and is considered harmful to the human eyes. Organic LED (OLED) lighting panel is thin, intrinsically planar, feeling naturally, and harmless to the human eyes. Now the major obstacle is the very high cost of vacuum process. The potentially low cost solution process under study for OLED include slot die coating, ink-jet printing, and spin coating. But they suffer from inter-layer mixing, low material usage, and high tank volume. Blade coating with substrate heating and hot wind is demonstrated to be a general platform for multi-layer deposition of unmodified small-molecule organic semiconductors with high fabrication throughput [Journal of Applied Physics, 110, 094501 (2011)] (Figure 1、2). Small molecules, originally designed for vacuum evaporation, can be blade coated as long as they have solubility above 0.5 wt%, which is satisfied for most molecules. So far our efficiency is 40 cd/A for green and orange, 25 cd/A for blue, and 34 cd/A for white emission. [Organic Electronics, 13, 914 (2012)]. The efficiency is close to vacuum evaporation for the similar device structure. Because of the capillary action beneath the blade gap, simple point source can be used to deliver the solution even during blade motion. This is in sharp contrast to slot die coating where precise linear delivery system is necessary and the film uniformity is difficult to control. With single solution delivery high uniformity is achieved for coating width of 25 cm. With continuous solution delivery the coated length is unlimited. Now we have a home-built working 30 cm blade coating, and a 120 cm coater is under final phase of assembly(Figure 3). some OLED prototypes are shown in figure 4.

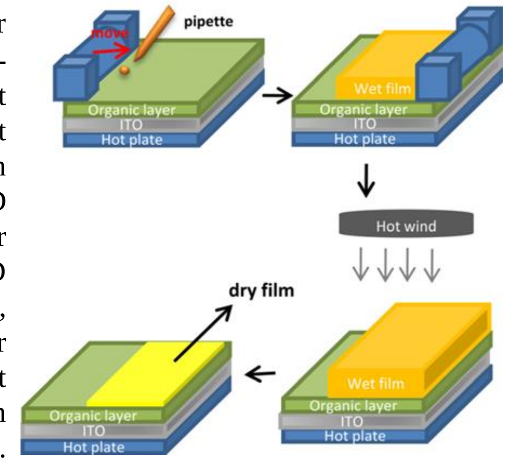

Figure 1:Thin wet film is formed quickly by blade followed by rapid drying to avoid inter-layer dissolution.

	Multilayer	Material waste	Tank volume	Throughput	Roll to roll
Spin	X	X	O	X	X
Slot –die	X	O	X	O	O
Ink-jet	X	O	X	X	O
Blade	O	O	O	O	O

Figure 2: Blade coating versus other solution depositions for semiconductors

Figure 3: (Left) 30 cm automatic blade coater
(Right) 120 cm coater under assembly

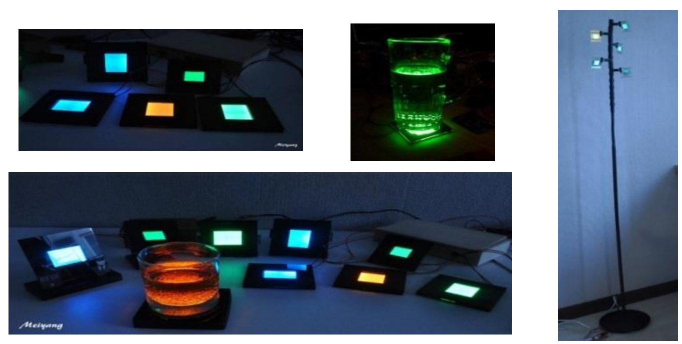

Figure 4: OLED prototypes