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HEAT TRANSFER ANALYSIS OF CIRCULAR SOURCE FOR OLED VAPOR DEPOSITON

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ABSTRACT

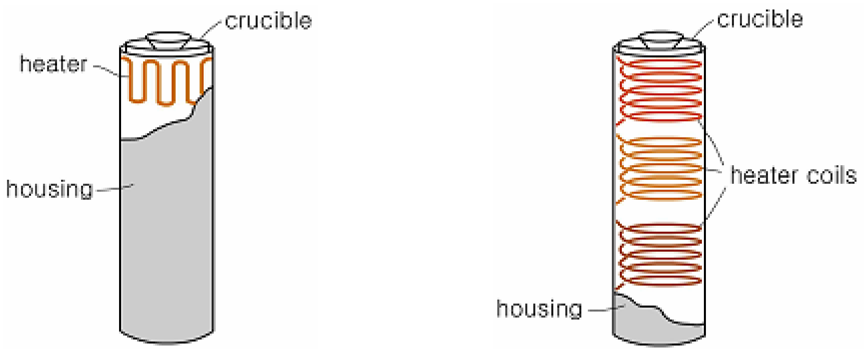
Organic light emitting diode (OLED) is one of the most promising type of future flat panel display. When an OLED panel is made, the organic vapor is deposited on a glass substrate in a vacuum chamber. A circular source is used to sublimate organic powder. An electric heater which is attached at the upper part of wall of crucible, which contains organic powder, supplies heat required to the sublimation of organic powder (Fig. 1 (a)). The top surface of organic powder should be controlled at about 300℃ for the sublimation. In order to spread organic vapor uniformly to the glass substrate, a nozzle is attached at the top part of circular source. As the sublimation progresses, the height of organic powder decreases, and the heater should provide more heat to keep the powder surface temperature at 300℃. However, if too much heat is added, the nozzle at the upper part of circular source becomes too hot and it affects bad effect on the uniformity of deposition. The nozzle should be kept at an optimal temperature, which is about 270℃.

A modified heater structure of circular source is suggested [1]. It has three separate heaters attached at the wall of crucible as sown in Fig. 1 (b). When the height of organic powder is low, the bottom heater provides most of heat needed for the powder sublimation. The upper part heater provides heat only to keep the nozzle at the optimal temperature. In order to show the improvement of thermal performance, a numerical analysis has been performed on the circular sources. A commercial CFD program, FLUENT, is used on the analysis. Because the circular source is symetric in azimuthal direction, it is analyzed in 2-dimension of *r-z* plane. Figure 2 shows one of the temperature distribution results of circular sources.

The nozzle temperatures of original heater structure and of modified heater structure are compared at Fig. 3. In all cases, the temperatures at the powder surface are 300℃. The nozzle temperature of orignial heater structure increases as the remaining quantity of organic powder decreases. When the remaining powder height is 20% of crucible depth, the nozzle temperature is 330℃, which is much higher than the optimal value, and the process should be stopped. However, in the modified heater structure, the nozzle temperature can be controled at the optimal value with the varition of organic powder

height. Even when the remaining powder height is 5%, the nozzle temperature can be kept at 270℃.

By controlling the nozzle temperature to the optimal value, the modified heater structure can provide more uniform deposition on the glass substrate than the original heater structure does. Moreover, it can use 15% more powder than the original heater structure can. It saves expansive organic powder as well as increases the productivity of large size glass substrate by increasing number of processing plates in a batch of powder loading.



(a) Original Heater structure (b) Modified heater structure

Fig. 1 Heater structure of circular source

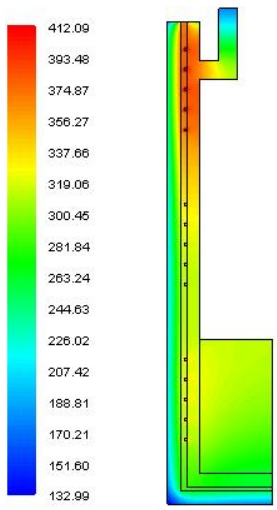


Fig. 2. Temperature distribution of circular source (modified heater structure)

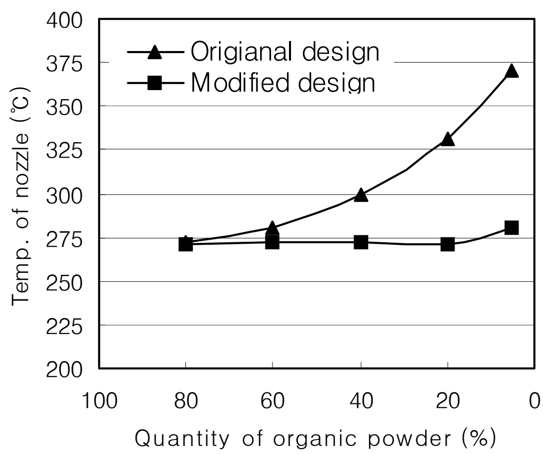


Fig.3. Distribution of nozzle temperatue for original and modified heater structure with vatiation of organic powder quantitiy

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