Nb/Ni Clad 전극을 이용한 고효율 CCFL 개발

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Development of CCFL with Nb/Ni Clad Electrode for high efficiency

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Abstract : According as CCFL(Cold Cathode Fluorescent lamp) of light source in Backlight unit for Note PC(Personal computer) is presently needed to low power consumption and long life time, the development focus of CCFL is going on the discharge gas, phosphor and electrode material. First of all, discharge voltage characteristic of CCFL is closely connected with electrode material. For low discharge voltage, the characteristic of electrode material is needed to low work function, low sputtering ratio and superior manufacturing property. We developed new CCFL with Nb/Ni Clad electrode superior to conventional CCFL. Because Nb/Ni Clad electrode with Ni material and Nb material, the electrical characteristic is superior to other electrode materials. The electrode of Nb/Ni Clad is composed that Ni of outside material has superior manufacturing property and Nb of inside material has low work function. Nb/Ni Clad of new electrode material is made by process of Rolling mill at high pressure and heat treatment. We compared electrical characteristic of Nb/Ni clad electrode with conventional Mo electrode by measurement. Mo electrode and Nb/Ni Clad electrode of cup type with diameter 1.1 mm and length 3.0mm are used to this experiment. Material content of Mo electrode is Mo 100%. But, Nb/Ni Clad electrode is composed by content of Nb 40% and Ni 60%. The result of comparison measurement between new CCFL with Nb/Ni Clad electrode and conventional CCFL was appeared that CCFL with Nb/Ni Clad electrode had superior characteristic than conventional CCFL. As a result of experiment, we completed Note PC with low power consumption and long life time by application of new CCFL with Nb/Ni Clad electrode.

Key Words : BLU, Nb/Ni Clad electrode, CCFL, LCD

1. 서 론

For development of CCFL with low power consumption by low discharge voltage, Nb/Ni Clad of electrode material was applied to new CCFL. Nb/Ni Clad electrode is composed by Ni material with superior manufacturing property and Nb with high secondary electron emission coefficient.

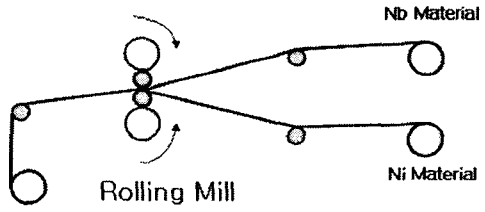


그림 1. Manufacturing process of Nb/Ni Clad.

Nb/Ni electrode has an effect on decrease of discharge voltage in discharge process of CCFL. Nb/Ni Clad electrode is made by process of Rolling mill at high pressure and heat treatment. Figure 1 is manufacturing process of Nb/Ni Clad. Nb/Ni Clad is manufactured from compression process by turning of rolling mill at high p ssure and Nb/Ni Clad is composed to Nb 40% and Ni 60%. After cladding process, Nb/Ni Clad is completed by progression of diffusion and firing process.

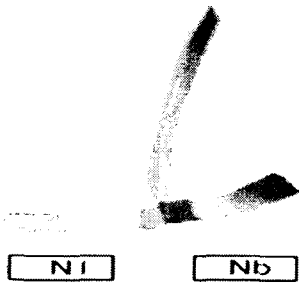
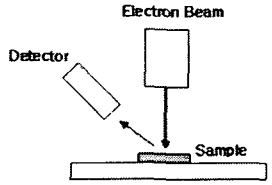


그림 2. Cross section of Nb/Ni Clad.

Figure 2 is cross section of Nb/Ni Clad electrode. We measured for characteristic comparison of CCFL with Nb/Ni Clad electrode and conventional CCFL.

2. 실 험

Light source in Backlight unit is needed to Note PC with low discharge voltage and long life time. For CCFL with low discharge voltage, it is very important to development of electrode material with high secondary electron emission ratio. So we measured secondary electron emission ratio by EPMA(Electron Probe Micro Analyzer) and sputtering ratio of each electrode material by IBE(Ion Beam Etching) method. Figure 3 is schematic of EPMA(Electron Probe Micro Analyzer) and measurement method of secondary electron emission ratio according to each electrode material.



EPMA	
Acceleration voltage	15.0kV
Beam size	1um
Bean current	0.05nA
Sampling size	640 X 480
Samoling time	0.04ms

그림 3. Schematic of EPMA.
(Electron Probe Micro Analyzer)

Figure 4 is measurement result by EPMA(Electron Probe Micro Analyzer). Relative secondary electron emission ratio of each electrode material is appeared by considering secondary electron emission ratio of Ni electrode material as basis value of 100%.

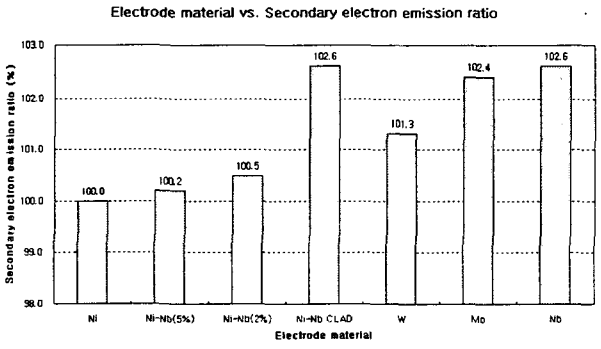
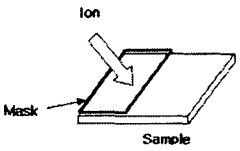


그림 4. Relative secondary electron emission ratio of each electrode materials.

In Measurement result, we know that Nb/Ni Clad electrode has the highest secondary electron emission ratio than other electrode materials. Because of this characteristic, CCFL with Nb/Ni Clad electrode could have lower discharge voltage than other electrode materials. Major characteristic together with low discharge voltage is life time in CCFL. Life time of CCFL is influenced by sputtering of electrode. According to decrease of sputtering ratio on electrode surface of CCFL, life time of CCFL could be elevated. Figure 5 is schematic of sputtering ratio measurement method on surface of each electrode materials by IBE(Ion Beam Etching).



IBE	
Acceleration voltage	500V
Current density	0.6mA/cm²
Gas pressure	Ar 1.3 X 10⁻⁴ Torr
Incident angle	45 deg.
Time	120 min

그림 5. Measurement method of IBE(Ion Beam Etching) and measurement condition.

Figure 6 is relative sputtering ratio of each electrode materials by considering sputtering ratio of Ni electrode material as basis value of 100%.

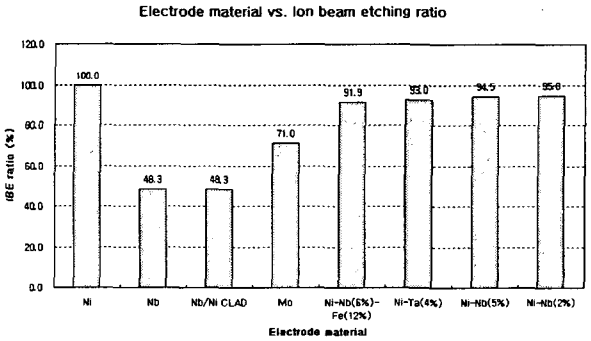


그림 6. Relative sputtering ratio of each electrode materials.

As a result of measurement, we know that Nb/Ni Clad material had lower sputtering ratio than other electrode materials. Eventually it is effect to long life time characteristic of CCFL. For low power consumption and improvement of life time, we applied Nb/Ni Clad electrode to new CCFL. And we completed that development of Note PC has low power consumption and long life time due to application of CCFL with Nb/Ni Clad electrode in LCD.

3. 결과 및 검토

Electrical characteristic of Nb material is equal to Nb/Ni Clad. But Nb material has weak point of strength and insufficient manufacturing property. For overcome of these weak points, we used to Nb/Ni Clad electrode with Ni of outside material and Nb of inside material. And We measured for characteristic comparison of CCFL with Nb/Ni Clad electrode and conventional CCFL. Figure 7 is measurement result of discharge voltage according to discharge current in each electrode materialsof CCFL. This experiment is proceeded by CCFL with diameter 2.0mm, length 348mm and pressure of buffer gas 60Torr(Ne 95%-Ar 5%).

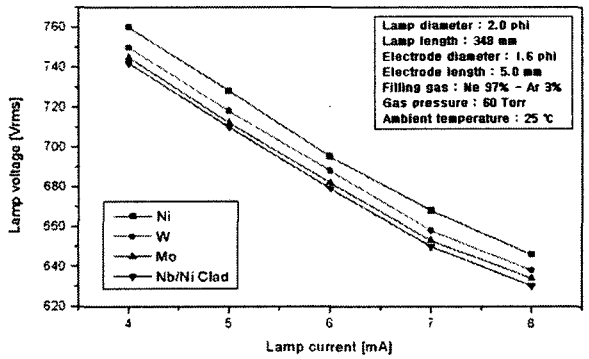


그림 **7.** Discharge voltage according to current in each electrode material

In this measurement result, we know that CCFL with Nb/Ni Clad electrode has the lowest discharge voltage of other electrode materials.
Figure 8 is measurement result of Hg(Mercury) consumption amount according to aging time of each electrode materials. According to the decrease of Hg(mercury) consumption amount, life time of CCFL is increased.

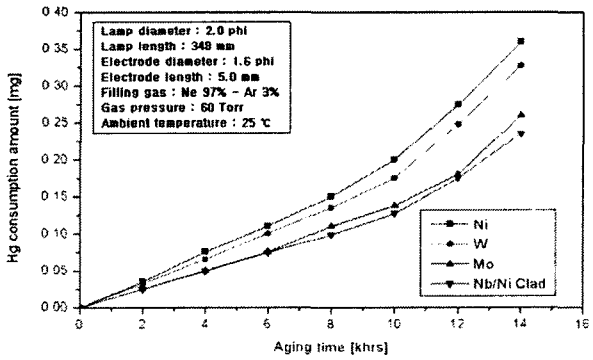


그림 *8.* Mercury consumption according to aging time.

4. 결 론

According to measurement result of Hg(mercury) consumption amount after aging time 14,000 hrs in Figure 8, we know that CCFL with Nb/Ni Clad electrode has the lowest Hg(mercury) consumption amount. And we know that Nb/Ni Clad electrode had superior electrical characteristic than other electrode materials by this result. Figure 9 is cross section of Nb/Ni Clad electrode by X-ray measurement.

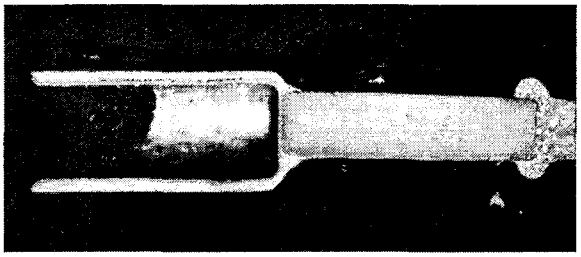


그림 **9.** Cross section of Nb/Ni Clad electrode by X-ray measurement

We knew that Nb/Ni Clad was composed with Nb of thickness 0.044mm and Ni of thickness 0.11mm by X-ray measurement. Figure 10 is obtained by measurement of discharge voltage according to current of CCFL with each electrode materials.

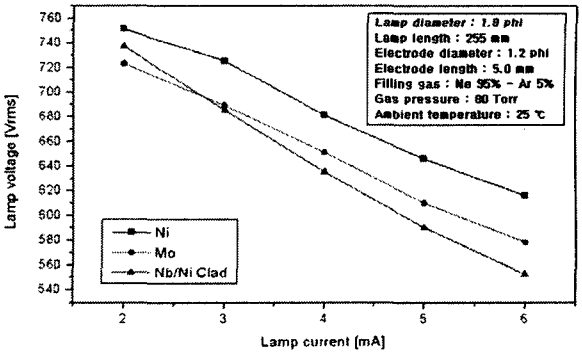


그림 **10.** Discharge voltage measurement according to current of CCFL with each electrode material

It is noted that CCFL withNb/Ni Clad electrode had lower discharge voltage than CCFL with other electrode materials by this measurement result.

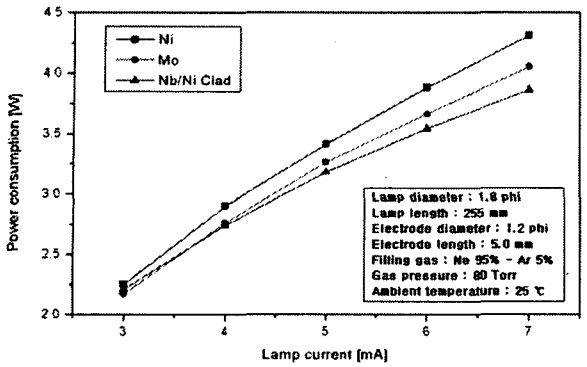


그림 11. Power consumption according to discharge current

Figure 11 is power consumption result according to current of CCFL with each electrode materials. In this result, CCFL with Nb/Ni Clad electrode had lower power consumption than conventional CCFL with Ni or Mo electrode. Finally we completed Note PC with low power consumption and long life time by application of CCFL with new Nb/Ni Clad electrode.

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