



# Development of mercury-free fluorescent lamps using double helical external electrodes (DHEL)

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## Introduction

Today use of hazardous substances are to be restricted

Mercury used for fluorescent lamp is not an exception because mercury is harmful to human being and environment.

The most effective gas in the rare gases used for a fluorescent lamp is xenon.

New method external electrodes lamp (DHEL) is developed by the authors.

## Results and discussion

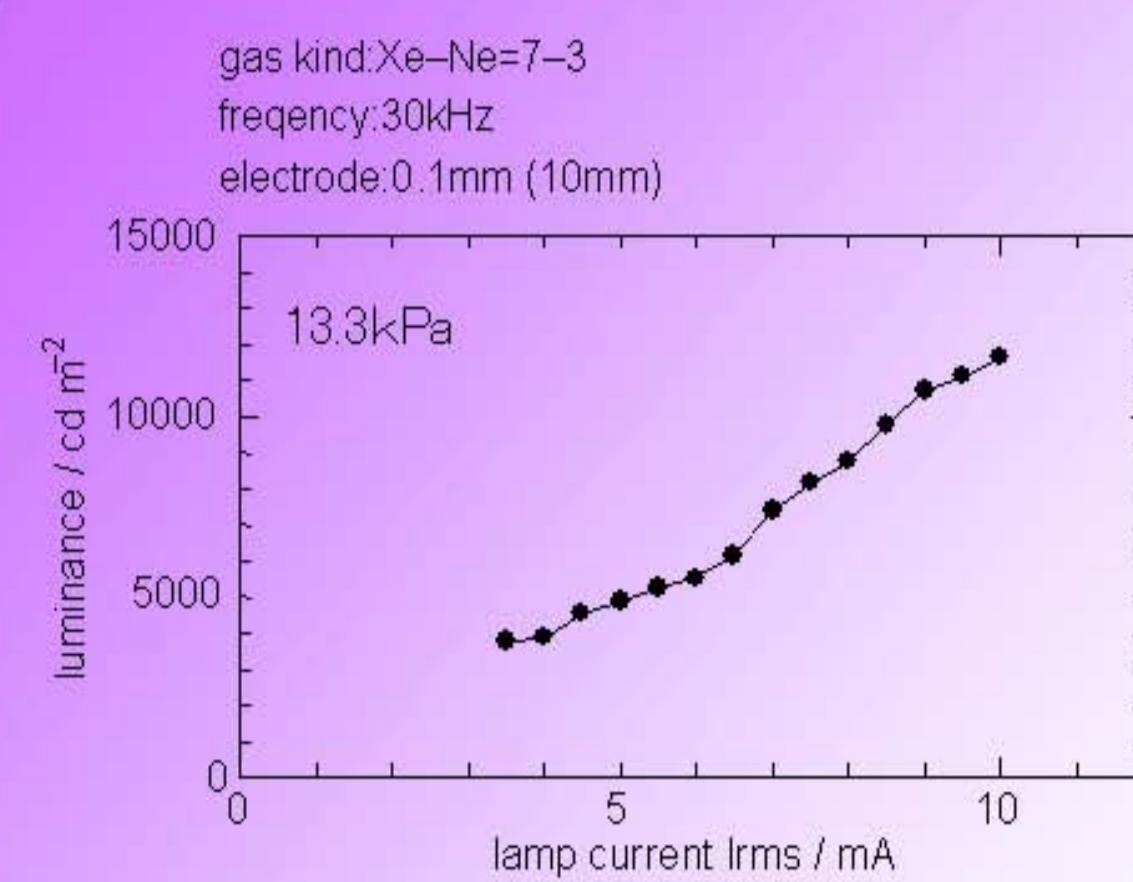


Fig 5 : Relation between discharge current and luminance of the DHEL

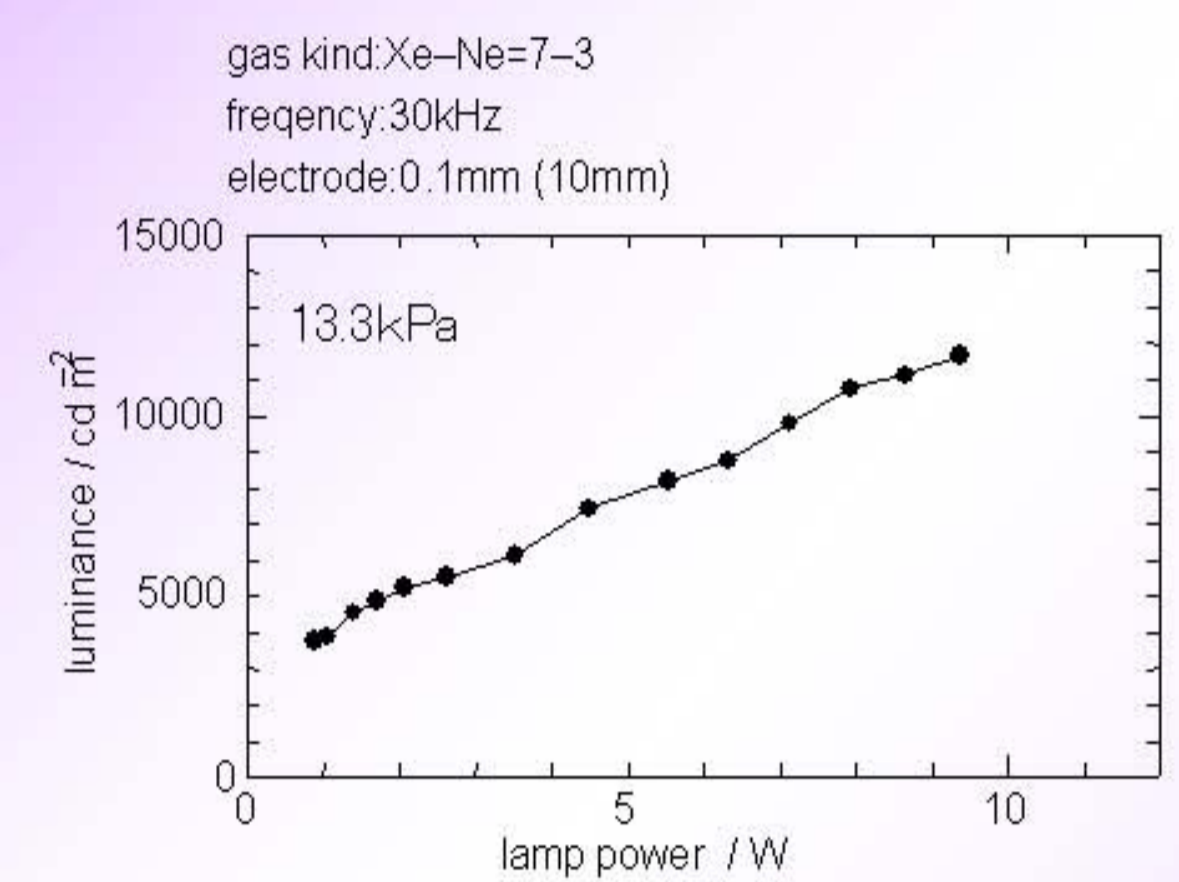


Fig 6 : Relation between lamp power and luminance of the DHEL

- At 8.5 W the luminance reached to **10000cd/m<sup>2</sup>**.
- Excellent in dimming property



Fig 7 : lighting state of the DHEL

In this DHEL, the contraction of the positive column is not observed.  
 Discharge paths are dispersed to each gap between each vicinal winds of anode and cathode and discharge occurs in two direction that is along and across the lamp axis.

## Conclusion

Luminance of the DHEL reached over **10000cd/m<sup>2</sup>**. (sinusoidal)

Optimization of the condition such as **electrodes pitch, gas pressure** and so on are needed.

## 1m long DHEL

1m long DHEL was made and lighting was tried.



Fig 8 : 1m long DHEL (before lighting)



Fig 9 : 1m long DHEL (lighting)

Uniform luminescence was obtained.

## Explanation of DHEL (Double Helical Electrodes Lamp)

### DHEL

Two thin metal wires are alternatively and helically wound with constant intervals on the outside of the DHEL as external electrodes.

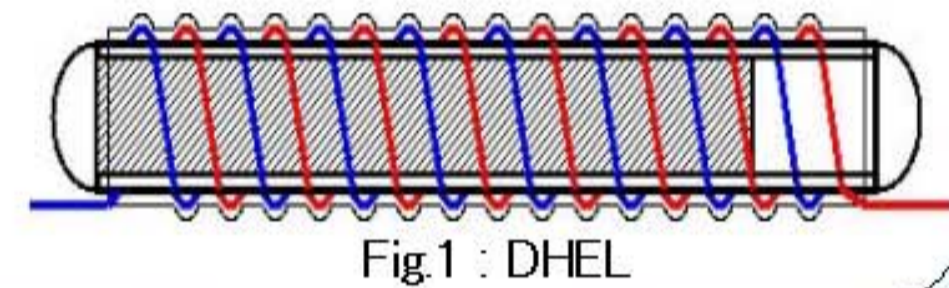


Fig 1 : DHEL

### Characteristic

	feature	factor
Length of lamp	No limit	• The discharge voltage is irrelevant to the length of the lamp. • Discharge occurs between adjacent winds electrode.
Light shielding area	Small in area	• the thin metal wires electrodes
Gas	Small limitation of the choice	• external electrodes (free from reaction between gas and electrode)
Life	Long	• external electrodes (free from degradation of electrode)

## Experimental setup

### Experiment method

The waveform of the applied voltage was sinusoidal and the frequency was 30kHz. Luminance, input power, and current were measured on this condition.

### DHEL used in this study

outer diamete :  $\phi 4.0\text{mm}$   
 (inner diameter :  $\phi 3.0\text{mm}$ )  
 gas : Xe:Ne=7:3 13.3kPa  
 phosphor: NP-107, NP-220, NP-360 (Nichia)  
 glass: borosilicate glass  
 pitch: 10mm (5mm)  
 electrodes :  $\phi 0.1\text{mm}$  (Ni)

Measurement point of the luminance was on the aperture and the center of the lamp.

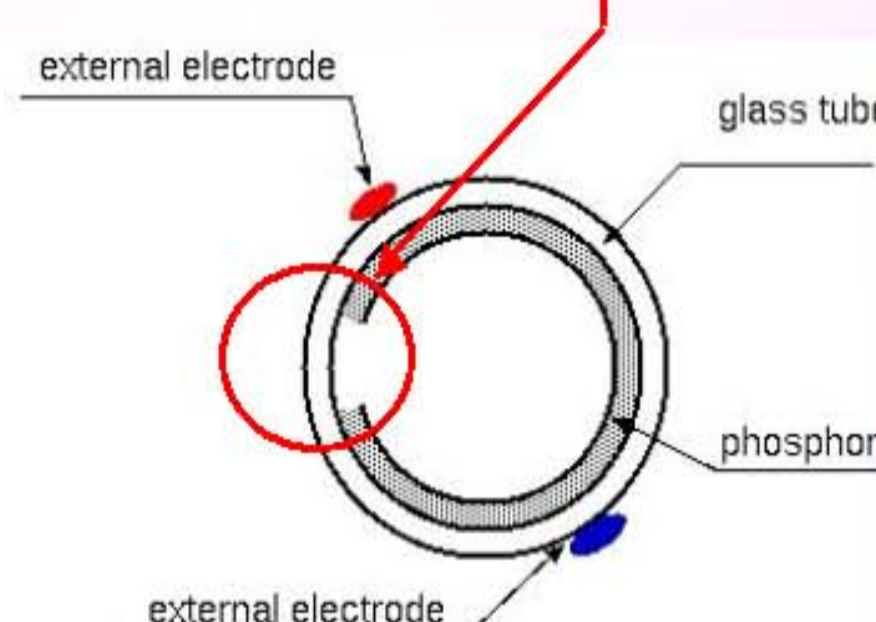


Fig 2 : DHEL used in this study (section view)

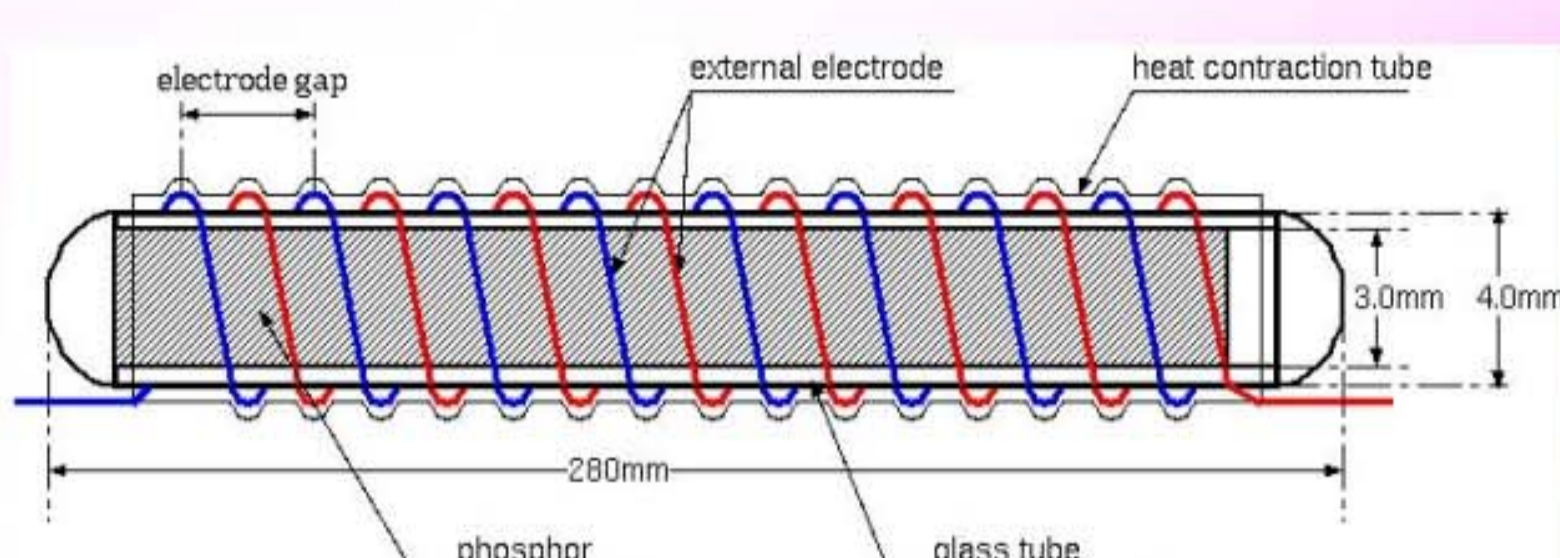


Fig 3 : DHEL used in this study (side view)

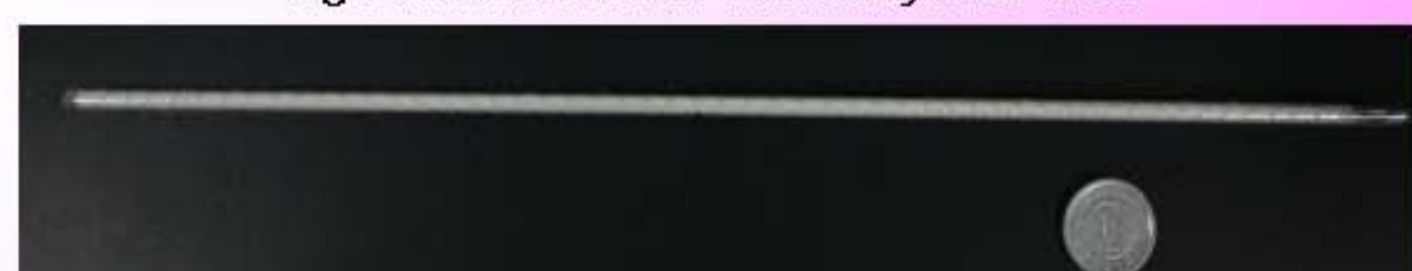


Fig 4 : DHEL used in this study (photo)

## Acknowledgment

The authors would like to thank Harison Toshiba Lighting Corp. for their financial and material support.