Radiation study for DC and microware (mw) HID lamps

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Advances in microwave and light source technology in the last decade have led to the most recent generation of highly efficient electrodeless discharge lamps. Such lamps are generally classified in the scientific literature as *electrodeless HID* (EHID) lamps, but currently they are often referred to as *plasma lamps.* The radiations of discharges sustained by a microwave (mw) electromagnetic field as well as discharges containing electrodes are discussed. The visible radiations are mainly important in light sources application while UV radiations are used extensively in water sterilisation.A 1D power balance model and ray-tracing method are both employed to calculated the radiations in these discharges.

1. General

In recent years, the use of an electrodeless light source excited by microwave electric fields has been widely used in our daily life and has attracted a great interest. The absence of electrodes provides greater flexibility in lamp design and the discharge is no longer limited by the narrow gap between the electrodes. In addition, the lack of inexpensive and efficient microwave power supplies has hampered the development of these lamps for many years. Pure Hg discharges are an ideal vehicle for a fundamental study, since the physical properties of mercury atoms have been well understood for many years.

2. Models

Zollweg [1] has deeply studied Hg DC discharges and has estimated the radiations of these lamps in different spectral range. The corresponding (same power) mw HID lamps are studied in this work. These discharges are considered to be excited by microwave electromagnetic fields in a cylindrical TM_{010} mode. A detailed theoretical analysis of these lamps was presented by Offermanns [2] and Waymouth [3]. We have already used in previous work [4] these analyses and obtained a representation of the temperature profile for DC discharges as well as for mw discharges.

3. DC and MW Discharges

Once the temperature profile for each lamp is known, the radiations in different spectral range are calculated using a model of radiation transport as in [4]. The obtained results for DC discharges at almost the same applied power are comparable with experimental results of Zollweg [1] as shown in Table 1.

Range (nm)	350-390	390-420	420-450	535-560	560-590
Model (W)	12.1	5.9	10.1	8.5	11.7
Zollweg (W)	14.4	7.5	10.7	12	15.2

Table 1: Radiations of each spectral range of the lamp

3. Results

We show in Figure 1 the increase in radiation as the applied electric power increases for both DC and mw discharges. The results show that the increase of radiation is almost linear with the applied power with a higher slope for DC discharge (blue line).

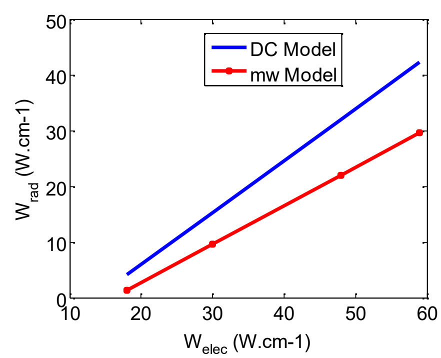

Figure 1: Variation of radiation with applied power

3. References

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