

The invention relates to a low-pressure mercury vapour discharge lamp in accordance with the preamble of Claim 1.

In general, low pressure mercury vapour discharge lamps are used for the disinfection of water or air. In addition to this, they are also used in the UV-irradiation of services. Low pressure mercury vapour discharge lamps generate UV radiation with a line spectrum with an intensive emission line of wavelength 253.7 nm and substantially weaker emission lines of wavelengths below 200 nm with a maximum at some 185 nm and 194 nm.

The short-wave proportion of the UV radiation of the wavelength range of below 200 nm is required for various photo-chemical processes such as the emission of approx. 185 nm for generating ozone from oxygen as well as for the hardening of paints and adhesives. In the preparation of ultra-pure water, too, such as is required for example in the electronics industry in the fabrication and manufacture of semi-conductors, this short-wave radiation allows for the photo-oxidative decomposition of contaminants.

With known low-pressure mercury vapour discharge lamps, however, the proportion as a percentage of short-wave radiation below 200 nm is relatively low in comparison with the proportion of radiation in the range from 254 nm, and with conventional low pressure mercury vapour discharge lamps this proportion of short-wave UV radiation from 185 nm - related to the proportion of the 254 nm radiation - is a maximum of only some 10 per cent.

Low pressure mercury vapour discharge lamps feature an optimum degree of efficiency at a specific mercury vapour pressure, related to the radiation output of 254 nm. The optimum vapour pressure is attained as a function of the cross-section of the lamp tube, usually with operational currents in the range from approximately 0.1 ampere to 1

ampere.

In order to achieve a higher radiation capacity, the principle is already known of increasing the operational current if a metallic filling forming an amalgam is arranged inside the lamp tube of the low pressure mercury vapour discharge lamp. As is known, the amalgam is a mercury alloy, which, for example, consists of mercury and indium. When such a metallic filling is provided on the inside of the lamp tube of the low pressure mercury vapour discharge lamp, between the electrodes or incandescent coils in the area of the discharge strip, the low pressure mercury vapour discharge lamp can be operated with a greater operational current, from some 2 to 3 ampere.

It has been shown in practice that even with use of the metallic filling as referred to above, no increase can be attained in the short-wave UV radiation in the range below 200 nm in comparison to the UV radiation at 254 nm. It may indeed be thought that the use of the metallic filling would increase the operational current still further, but it has transpired that no increase in radiation strength is to be achieved in this way.

The invention is based on the objective of improving the low pressure mercury vapour discharge lamp of the type referred to in the preamble of Claim 1, in such a way that despite the circumstances described previously, a substantial increase will be achieved in the short-wave UV radiation in the range from 170 to 200 nm, and in particular in the emission line from 185 nm in comparison to the UV radiation from 254 nm.

This objective is achieved according to the invention by the features in the characterisation section of Claim 1.

According to the invention, the use of the inherently-known

amalgam forming the metallic filling is a precondition, but in an innovative manner provision is made for the outer wall of the lamp tube to be in contact with a cooler at the point at which the metallic filling is located on the inner wall of the lamp tube.

This measure results in a cooling effect at the point concerned, with the effect that the low pressure mercury vapour discharge lamp can be operated with a substantially higher operating current. As a result of this higher operating current, a surprisingly distinct increase in the short-wave UV radiation in the range from 170 - 200 nm, and in particular from 185 nm, in comparison to the UV radiation from 254 nm, in the manner intended, can be observed.

The invention is based on the recognition that the operational vapour pressure of the low pressure mercury vapour discharge lamp depends on the wall temperature of the lamp tube and on the electrical operating parameters. As a result, with known low pressure mercury vapour discharge lamps, the possibility referred to earlier of increasing the operating current will not lead to an increase in the radiation capacity, because the lamp tube of the low pressure mercury vapour discharge lamp will then become too hot, and the optimum operating vapour pressure of the mercury will not be attained. Thanks to the cooling effect provided for by the invention, by contrast, the low pressure mercury vapour discharge lamp can very readily be operated with a higher operating current, with the result that the short-wave UV radiation in the range from 170 - 200 nm increases perceptibly, since the cooling effect prevents the operational vapour pressure in the lamp from rising, and exceeding the saturation point.

Measurements on a low pressure mercury vapour discharge lamp according to the invention were able to confirm in experiments that the proportion as a percentage of the

short-wave UV radiation from approx. 185 nm - related to the radiation proportion from 254 nm - could be increased up to values of 90 per cent. This is a multiple of what was possible with previous low pressure mercury vapour discharge lamps. This, for example, with the new low pressure mercury vapour discharge lamp a decidedly higher photolytic or photo-oxidative effect can be achieved, which, for example, is of particular advantage in the treatment of ultra-pure water.

One embodiment of the invention which fulfils this purpose provides for the metallic filling to be arranged inside one or more bulge formations on the lamp tube, facing radially outwards, and that the bulge formations are at least in contact with a cooler.

With this further embodiment of the invention, the metallic fillings are no longer arranged as hitherto on the smooth inner wall of the lamp tube; rather, the lamp tube is provided with bulge formations pointing outwards, in the form of depressions, which form indentations in the nature of a crucible, and the metallic fillings are located inside these bulge formations. In this situation, the bulge formations are at least partially in contact with a cooler, as a result of which a cooling effect is in turn achieved, which allows for the substantial increase of the operating current and therefore the perceptible increase in the short-wave UV radiation in the range from 170 - 200 nm.

In order to achieve the cooling effect provided for as an important measure in the invention, a further purposeful embodiment of the invention provides for the metallic filling to be arranged in the immediate vicinity of the aforementioned bulge formations. In this situation a decisive factor is that the metallic fillings are arranged so closely to the bulge formations referred to, that they are located in the area of effect of the cooling zone, and a

father clear cooling effect is achieved.

In accordance with another advantage embodiment of the invention, the low pressure mercury vapour discharge lamp is arranged in an envelope tube permeable for UV radiation, in such a way that the bulge formations of the lamp tube are at least partially in contact with the outer envelope tube, in which context the envelope tube forms the cooler element.

This embodiment is, for example, of advantage, if the low pressure mercury vapour discharge lamp is formed with the outer envelope tube as an immersion radiator, in which situation the envelope tube is surrounded by a fluid medium. This fluid medium then supports the cooling effect in an advantageous manner.

Within the scope of the invention, in accordance with a further purposeful embodiment of the invention, it is also possible for the aforementioned envelope tube to feature, at the metallic filling points, a number of bulge formations facing radially inwards, which are in contact with the said points of the metallic fillings, in which situation the envelope tube forms the cooler element. A decisive factor in this context is that the metallic fillings are in each case in contact with the outer envelope tube which contributes to the cooling effect.

To advantage, the lamp tube of the low pressure mercury vapour discharge lamp features a cross-section of at least 0.5 cm^2 and maximum 12 cm^2 , for preference approximately 3 cm^2 .

In a further embodiment of the invention, the lamp tube has, in the area of its discharge path, a cross-section at least 30 per cent smaller than at the two outer ends in the area of the electrodes. Accordingly at the two outer ends. the lamp tube has sections with a larger cross-section than in

the centre, in the actual discharge area.

In a further embodiment of the invention, the metallic fillings and the outward bulge formations of the lamp tube, or also the inward bulge formations of the envelope tube, as referred to, are located in the area of the electrodes; i.e. in the area of the ends with the large cross-sections.

Another variation provides for the metallic fillings to be located in the area of the discharge path of the lamp tube, i.e. in the area with the smaller cross-section. In this situation, for preference, one metallic filling is arranged in each case on each side, adjacent to the areas with the larger cross-section.

The invention can also be applied with advantage if the lamp tube features a flat longitudinal cross-section which deviates from a circular shape, with two broad sides (radiation sides) and two narrow sides, and is designed as an inherently-known flat radiator. The bulge formations and the metallic fillings respectively are then located on at least one narrow side of the flat radiator.

Further purposeful embodiments of the invention are described in the sub-claims.

The invention is explained in greater detail hereinafter on the basis of the embodiments illustrated in the drawings. These show:

Fig. 1 -9 various different embodiments of a low pressure mercury vapour discharge lamp and

Fig. 10 a graphic representation of the proportions of wavelengths and emission lines respectively at approx. 185 nm and approx 254 nm of the UV radiation.

Fig. 1 shows a low-pressure mercury vapour discharge lamp 10 with a lamp tube 12. The lamp tube 12 has an inner wall 14 and an outer wall 28. At each end is a socket 22 with electrical connection pins 24, which are in connection with the electrodes 20 (incandescent coils) provided in the inside of the lamp tube.

A metallic filling 32 is firmly secured on the inner wall 14 of the lamp tube 12, in the area between the electrodes 20, and at the point located opposite, the outer wall 28 of the lamp tube 12 is in contact with a cooler 46, which can, for example, be formed by a cooling plate. The cooler 46 exerts a cooling effect in the area of the metallic filling 32, with the result that the low pressure mercury vapour discharge lamp 10 can be operated with a comparatively high operating current of greater than 2.5 ampere. As a result of this, a decisive increase is attained in the short-wave UV radiation in the range from 170 nm - 200 nm, in comparison to the UV radiation of approximately 254 nm.

The representation in Fig. 2 shows a low pressure mercury vapour discharge lamp 10, in which two metallic fillings 32 are provided. In this case, the lamp tube 12 has two corresponding bulge formations 30, pointing radially outwards, in which the metallic fillings 32 are located. On the outer wall of the lamp tube 12, these bulge formations 30 are in contact with the coolers 46.

Fig. 3 likewise shows a variant of a lamp tube with a bulge formation 30, which is in contact with its outside with the cooler 46, but in this case the metallic filling 32 is not in the bulge formation 30 itself, but arranged in the immediate vicinity. In this case, the metallic filling 32 is still in the area of effect of the cooler 46, with the result that a cooling effect can take place in this case also.

With the embodiment shown in Fig. 4, the low pressure mercury vapour discharge lamp 10 is designed as an immersion radiator, since the lamp tube 12 is located inside an envelope tube 26, which is permeable for UV radiation. The bulge formation 30, in which the metallic filling 32 is located, is in contact with the envelope tube 26, which therefore forms the cooler. Conventionally immersion radiators are used for the irradiation of fluids, which then surround the envelope tube 26, as a result the envelope tube 26 is particularly well-suited to take on the function of a cooler.

The representation in Fig. 5 also shows a low-pressure mercury vapour discharge lamp 10 with an external envelope tube 26. This envelope tube 26 has an inward bulge formation 44, which is in contact with the outer wall 28 of the inner lamp tube 12, and specifically at the place at which the metallic filling 32 is arranged on the inner wall. In this case, the said metallic filling is located directly on the inner wall 14 of the lamp tube 12, i.e., as a departure from Fig. 4, no outwards bulge formation is provided in this case; in practical terms, the outwards bulge formation is replaced by the inwards bulge formation 44.

Fig. 6 shows a partial representation of another embodiment in which for spacial reasons only one end of the low pressure mercury vapour discharge lamp 10 is shown. In this case, the lamp tube 12 has a larger cross-section at both ends in the area of the electrodes 20 than in the area of the actual discharge path 18, i.e. in the middle area. The cross-section in the middle area of the discharge path 18 is at least 30 per cent smaller than in the area of the ends 16 with the greater cross-section.

The minimum of one metallic filling 32 is arranged in the area of the one end 16 with the greater cross-section on the inner wall 14 of the lamp tube 12, and is in turn in contact

with a cooler 46, which in this case, in the area of the metallic filling 32, has an inwards bulge formation which is directed radially inwards. The cooler 46 could therefore also be formed by the envelope tube 26 shown in Fig. 5.

Fig. 7 likewise shows a low-pressure mercury vapour discharge lamp 10, in which the ends of the lamp tube 12 feature a greater cross-section 16 than the discharge path 18. The difference to Fig. 6 lies in the fact that the metallic filling 32, is arranged in the outwards bulge formation 30, and that the cooler 46 runs on a flat plane.

The embodiment in accordance with Fig. 8 also shows a lamp tube 12, in which the ends 16 have an enlarged cross-section. The metallic filling 32 is, however, not arranged in the area of the enlarged cross-section 16, but in the area of the discharged path 18 in the outwards bulge formation 30, which is in contact with the cooler 46.

Finally, Fig. 9 shows as a further embodiment in a partial representation a flat radiator 34, in which the lamp tube has two broad sides 36 and two narrow sides 38. The outward bulge formation 30 for accommodating a metallic filling is in this case located on a narrow side 38 of the flat radiator 34. This outwards bulge formation is likewise in contact with a cooler or with an envelope tube, this not being shown in greater detail in Fig. 9.

Fig. 10 shows, in a graphic representation, the wavelengths or emission lines respectively of the UV radiation generated with a low pressure mercury vapour discharge lamp in accordance with the invention. A particularly noteworthy point is the emission lines of the short-wave UV radiation 40 of the wavelength of approximately 185 nm, and the emission radiation 42 of the wavelength of approximately 254 nm.

As can be seen, the short-wave proportion 40 of the radiation of 185 nm amounts to almost 90 per cent of the proportion of the radiation 42 of 254 nm. Such a high proportion, as a percentage, of the short-wave radiation 40 of 185 nm in comparison to the radiation 42 of 254 nm, is entirely surprising and has not been capable of achievement hitherto.



CLAIMS

1. A low-pressure mercury vapour lamp (10) with a lamp tube (12) and with at least one metallic filling (32) forming an amalgam located on the inner wall (14) thereof, for the generation of UV radiation in the wavelength range from approx 170 nm - 280 nm for the irradiation of fluid or gaseous media and/or of surfaces, characterized in that the metallic filling (32) is arranged between the electrode (20) of the low-pressure mercury vapour lamp (10) on the inner wall (14) of the lamp tube (12), and that the outer wall brackets (28) of the area of the lamp tube (12) corresponding to this place on the inner wall (14) is in contact with a cooler (26; 46).

2. A low-pressure mercury vapour lamp (10) in accordance with Claim 1, characterized in that the metallic filling (32) is arranged inside one or more outward bulge formations (30) of the lamp tube (12), pointing radially outwards, and that the outwards bulge formations (30) are at least partially in contact with a cooler (26; 46).

3. A low-pressure mercury vapour lamp (10) in accordance with claim 1, characterized in that the metallic filling (32) is arranged in the immediate vicinity of one or more outwards bulge formations (30) of the lamp tube (12) pointing radially outwards, and that the outwards bulge formations (30) are at least partially in contact with a cooler (26; 46).

4. A low-pressure mercury vapour lamp (10) in accordance with one or more of the foregoing Claims 1 - 3, characterized in that the low-pressure mercury vapour lamp (10) is arranged in an envelope tube (26) permeable for UV radiation, that the outwards bulge formations (30) of the lamp tube (12) are at least partially in contact with the outer envelope tube (26), and that the envelope tube (26)



forms the cooler.

5. A low-pressure mercury vapour lamp (10) in accordance with Claim 1, characterized in that the low-pressure mercury vapour lamp (10) is arranged in an envelope tube (26) permeable for UV radiation, that the envelope tube (26) features inwards bulge formations (44), pointing radially inwards, which are in contact with the said points of the metallic filling (32) in which context the envelope tube (26) forms the cooler.

6. A low-pressure mercury vapour lamp (10) in accordance with one or more of the foregoing Claims 1 - 5, characterized in that the lamp tube (12) has a cross-section of at least 0.5 cm^2 and a maximum of 12 cm^2 .

7. A low-pressure mercury vapour lamp (10) in accordance with one or more of the foregoing Claims 1 - 6, characterized in that the lamp tube (12) features a cross-section in the area of its discharge path (18) which is at least 30 per cent smaller than at the two outer ends (16) in the area of the electrodes (20).

8. A low-pressure mercury vapour lamp (10) in accordance with one or more of the foregoing Claims 1 - 7, characterized in that the operating current through the low-pressure mercury vapour lamp (10) is greater than 2.5 ampere.

9. A low-pressure mercury vapour lamp (10) in accordance with one or more of the foregoing Claims 1 - 8, characterized in that the metallic fillings (32) or the outward bulge formations (30) of the lamp tube (12) or the inwards bulge formations (44) of the envelope tube (26) are arranged in the area of the larger lamp tube cross-section (16).



10. A low-pressure mercury vapour lamp (10) in accordance with one or more of the foregoing Claims 1 - 9, characterized in that the lamp tube (12) features a flat longitudinal cross-section which deviates from a circular shape, with two broad sides (36) (radiation sides) and two narrow sides (38), and is formed as an inherently-known flat radiator (34).

11. A low-pressure mercury vapour lamp (10) in accordance with Claim 10, characterized in that metallic fillings (32) or the outwards bulge formations (30) are located on at least one narrow side (38) of the flat radiator (34).