



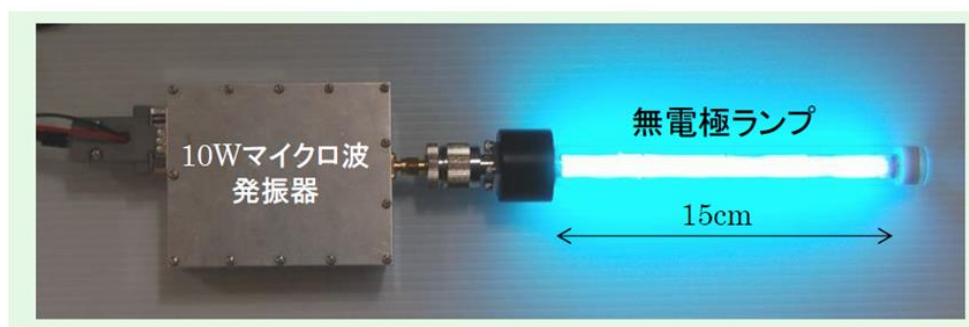
Theme Name	Application of 254 nm ultraviolet emission electrodeless lamp system with low power consumption and long life time to sterilization systems
Organization Name	Plasma Applications, Inc.
Technical field	Manufacturing, environmental / organic chemistry, inorganic chemistry, medical collaboration / life sciences

Overview

The developed ultraviolet emission electrodeless lamps shows strong emission at 254 nm and can be used for sterilization systems. Other applications can be considered using such properties as high-efficiency, small-size, and long-life. Though the low power microwave is used to ignite the lamps, there is almost no leakage of microwaves. Therefore there is no electromagnetic effect on the peripheral device or systems. In combination with our compact 2.45 GHz microwave oscillator, it is possible to construct sterilization systems with low power consumption and long life, which are small and relatively inexpensive. We welcome to companies that wish to introduce and apply this product.

Simplified

With 254 nm UV emitting electrodeless lamp system
 Application to low power consumption and long life sterilization systems



10 W microwave oscillator

Electrodeless lamp (150 mm long and 10 mm in diameter)

(Feature)

- 1) Light up with low microwave power (5 W-10 W)
- 2) UV-C radiation conversion ratio is high (~30 % for microwave power)



- 3) High luminous efficiency even with a short length (50 to 150 mm long)
- 4) Emission of UV-C radiation, which has a high sterilizing effect
- 5) No microwave leakage
- 6) Long life

(Application field)

It can be applied not only to mainly sterilization but to various purposes.

- 1) Medical / nursing fields

Sterilization of beds, linen, masks et al.

Automatic sterilization systems such as inside hospital rooms, operating rooms, ambulances and doctor cars

- 2) Food and beverage sector

Sterilization in restaurants, dining tables, counters, cookware, food factories, etc.

Background

The electrodeless lamp, as its name suggests, is a lamp without electrodes. It is characterized by the fact that even if the lamps are repeatedly turned on or off, electrode consumption like AC/DC discharge lamps does not occur, which makes the lamp life time very long. In addition, there are no dark space in front of the cathode, so that UV-C emission becomes strong and leads to higher lamp efficiency, even if the lamp length is relatively shorter.

This technology uses UV-C light emission from the microwave discharge, but microwave leakage is suppressed negligibly small and therefore there is no electromagnetic effect on the peripheral devices or systems. In combination with our compact 2.45 GHz microwave oscillators, small and relatively inexpensive sterilization systems can be constructed with low power consumption and long life time. We welcome to companies that wish to introduce and apply this product. Plasma Applications Co., Ltd. is a university venture established by Professor Masashi Kando of Shizuoka University (formerly) Electronic science research institute. By joint research with TOKYO KEIKI Co., Ltd. (headquartered in Ota Ward, Tokyo) in 2015 and 2016 years, the Company developed the research results of the NEDO contract research in fiscal year 2016.

Technical Content

The UV-emitting electrodeless lamp has been developed by the design of a tubular metal mesh member.

- Low microwave power (5W ~10W)
- The UV-C luminous efficiency per lamp length (~200 mW/cm) is high (for the lamp length : ~ 5 cm to 15 cm).
- No microwave leakage
- There are no UV-C emission parts along the lamp axis

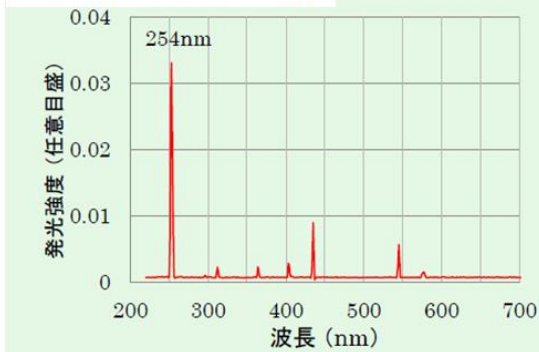
The emission spectrum is as follows :

As shown in the figures below, ozone generation type (right figure) which emits 185 nm line spectrum in ozone generation wavelength range and no ozone emission type (left figure).

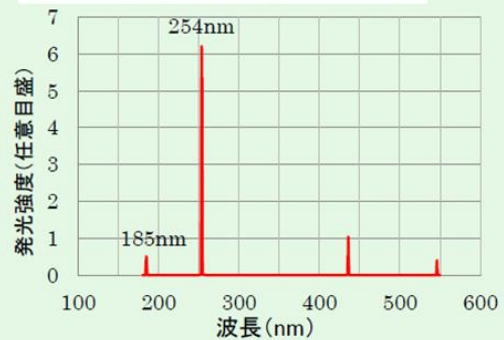
○ Emission spectrum

(Lamp shape: outer diameter 10 mm, length 150 mm, microwave input: 10 W)

1) Ozone-less UV-C lamp



2) Ozone generating UV-C lamp



Both types exhibit high bactericidal performance.

○ UV-C (wavelength 200-280nm UV) germicidal effect

Number of colonies without UV-C irradiation: 1074

Number of colonies after UV-C irradiation for 10 seconds: 0



There are several different products, such as dimensions.

○ Types and characteristics of UV lamps



Lamp number	Lamp length (mm)	Lamp outer diameter (mm)	Maximum conversion efficiency (%)	UV-C output (W)	Microwave input (W)	Lamp wall minimum temperature (°C)	Lamp wall maximum temperature (°C)
1	50	10	25	1.25	5	55	50
2	100	10	25	1.75	7	67	50
3	150	10	30	3	10	62	47
4	300	30	30	12	40	80	60

Remark)

1 Maximum conversion efficiencies for microwave input power and lamp size are shown.

2 If the microwave input exceeds this level, the UV output will increase but conversion efficiency decreases.

○Microwave components for ultraviolet lamps ignition

Product name	Specifications
Solid-state microwave oscillator	Lamp number 1-3... Oscillator with output of 10 W, power supply: AC100V Lamp number 4... Oscillator with output of 50 W, power supply: AC100V
AC adapter	AC / DC converter for driving solid-state microwave oscillator
Matching element	2.45GHz simple structure tuner
Other	Depending on the application, various adapters, quartz lamp tubes, reflectors et al. are used

Strengths of technologies and know-how (novelty, superiority, utility)

The features of this technology are as follows.

- 1) Low-power microwave (5W ~10W) can be lit.
- 2) UV radiation efficiency per lamp length is high (~200 mW/cm) even in the case of short lamps (5 cm to 15 cm length).
- 3) Sterilization effect is high.



Example : 5L water mixed with indicator microorganisms (Escherichia coli, Bacillus subtilis) can be sterilized at more than 99.9 % by 10 seconds UV-C irradiation.

4) There is no microwave leakage, and ozone generation does not occur in the ozone-less type.

5) Long life.

Therefore, the UV-C lamps shown in the table are compact, lightweight, and easy to carry, and can be sterilized evenly in narrow spaces. It is expected to be used these products in industries such as medical, nursing, and eating.

Image of a cooperative company

We welcome to companies that wish to introduce these equipments and apply this technology. For example, we can cooperate with the following companies.

1) Companies, hospitals, and research institutions related to medical and nursing care.

Those interested in the use of the following applications

- Disinfection of vomit on the floor and bed linen etc.
- Sterilization inside the room, operating room, ambulances, and doctor car (These products can quickly sterilize inside and outside of the room and inside of the interior of the car under the non-shaded condition.)

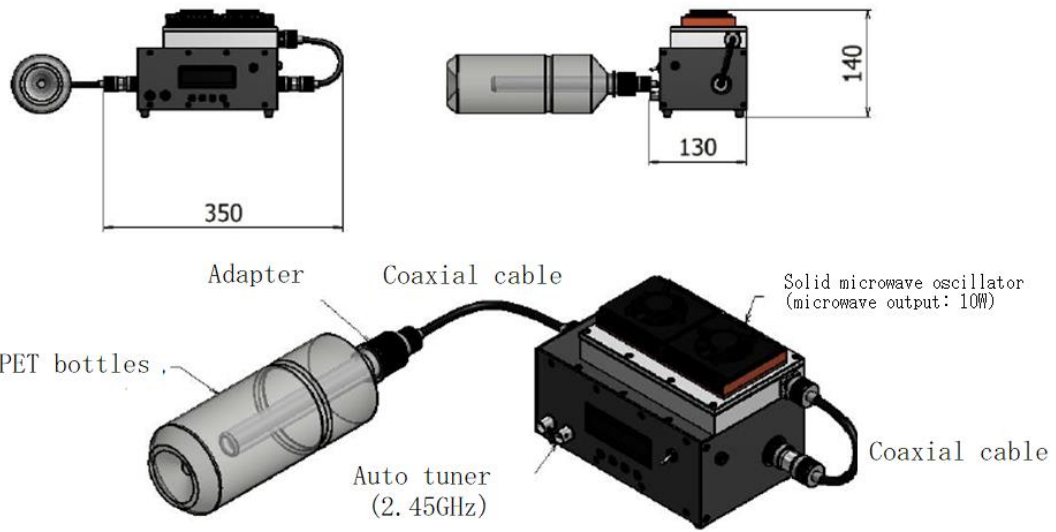
2) Companies that are involved in food and drink, and are interested in the use of the following applications

- Sterilization of food stores, dining tables, cooking utensils, food factories, etc.
- Sterilization of narrow spaces (food storage cabinets, toilets, etc.)
- High-speed sterilization of containers, water and solutions (less than a few seconds in a 2L bottle solution)

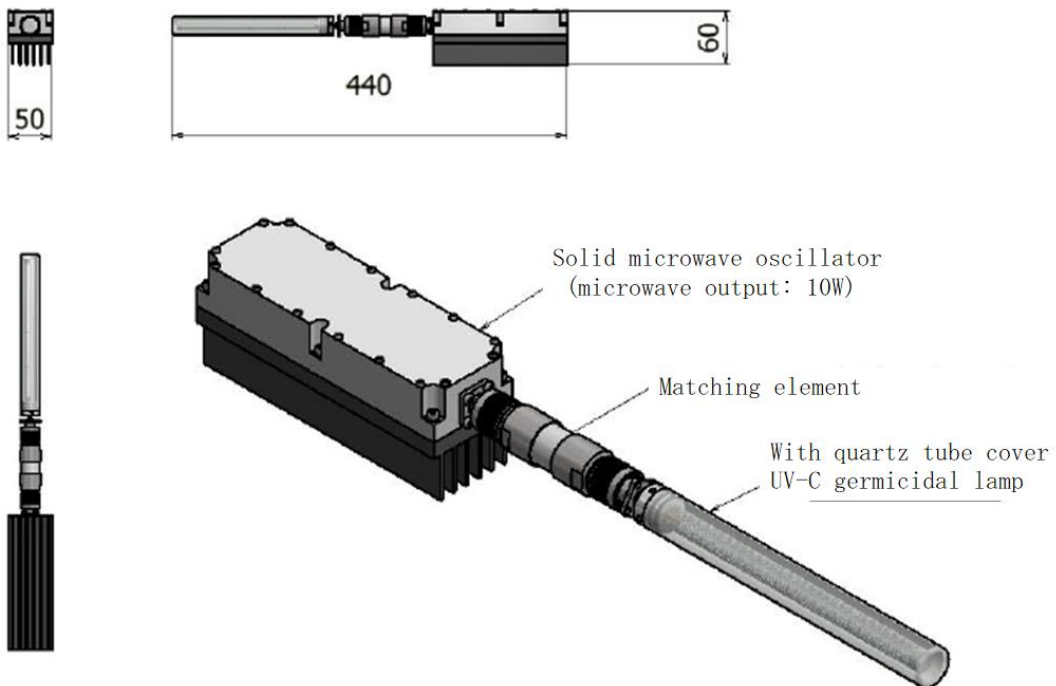
3) Other companies that are motivated to develop business based on this technology.

Utilization of technologies and know-how (images)

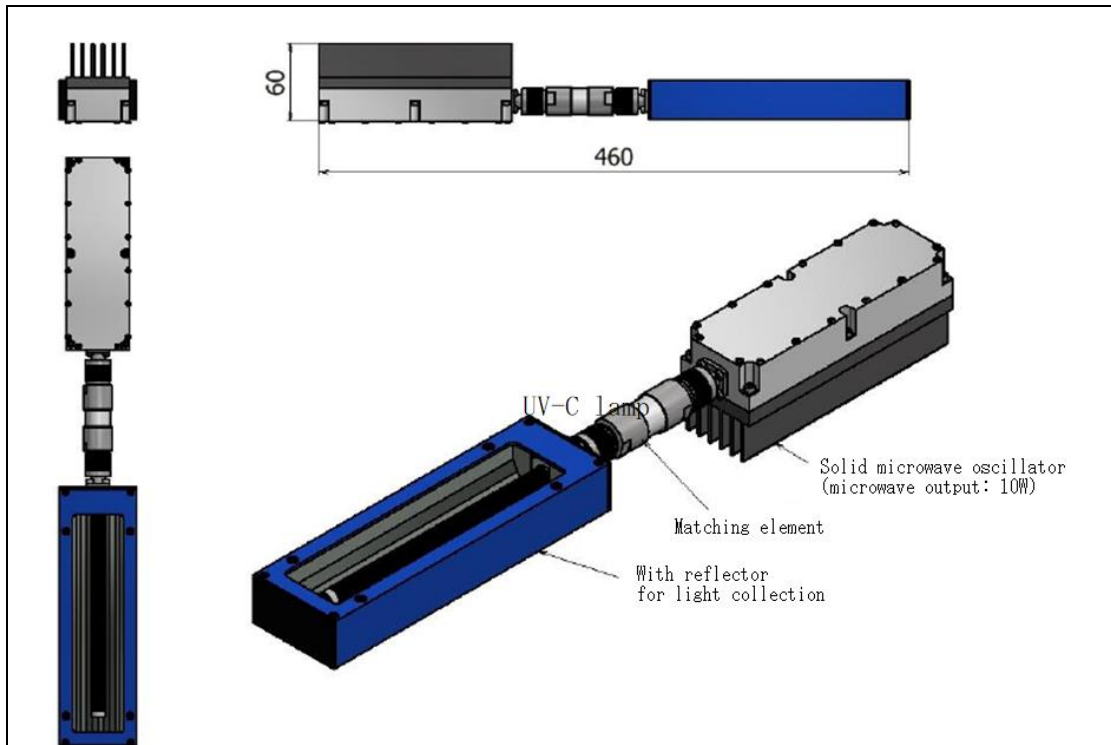
[Application Example 1] Example of sterilization system configuration of containers such as PET bottles (dimensions : mm)



[Application Example 2] Portable Water Sterilizer (Dimensions : mm)



[Application Example 3] Portable Surface Sterilization Equipment (Dimensions : mm)



The object surface exposed to the UV-C lamp can be sterilized more than or equal to 99.9 % of the object surface by sweeping the equipment 1 cm apart from the object surface in the sweep speed of 2.5 cm/sec.

Flow of technology and know-how

We can also deal with the consignment of sterilization equipment according to the application. We will give you a detailed explanation of the technology. Please feel free to contact us about your application.

Description of the technical terms

[UV-C]

It is ultraviolet C wave. Ultraviolet rays include UV-A (ultraviolet A wave : 315 to 380 nm, cause of skin aging due to sunlight), UV-B (ultraviolet B wave : 280 to 315 nm, cause of skin sunburn), UV-C (ultraviolet ray C wave : 200 to 280 nm, strong sterilization effect).