Characteristics, Development and Application of Excimer Flow-Through Photoreactors (FTPs)

Thomas Oppenländer
Hochschule Furtwangen University (HFU), Campus Villingen-Schwenningen, Faculty of Medical and Life Sciences, Jakob-Kienzle-Str. 17, 78054 Villingen-Schwenningen, Germany
Tel. +49-7720-307-4223, Email: op@hs-furtwangen.de

The historical development of modern dielectric barrier discharge (DBD) driven excimer lamps (excilamps)[1] is reviewed briefly. Excilamps are mercury-free sources of intense and almost monochromatic vacuum-UV (VUV) or UV radiation, depending on the rare gas or rare gas/halogen mixture used for the production of radiation. Their characteristics concerning the extraordinary geometrical variability, process reliability and technical practicability are discussed and demonstrated by conclusive examples from our laboratory. The application of xenon (Xe_2*, λ_{max} = 172 nm) and of kryptonchloride (KrCl*, λ_{max} = 222 nm) excilamp flow-through photoreactors (FTPs, see Figure)[2] for water and air treatment is presented with respect to VUV photochemically induced oxidation and mineralization of organic compounds. Additionally, a comparative study of VUV (172 nm) and UV(222 nm, 254 nm) disinfection using *Bacillus subtilis* spores demonstrates the superior disinfection efficiency of the KrCl* excilamp.

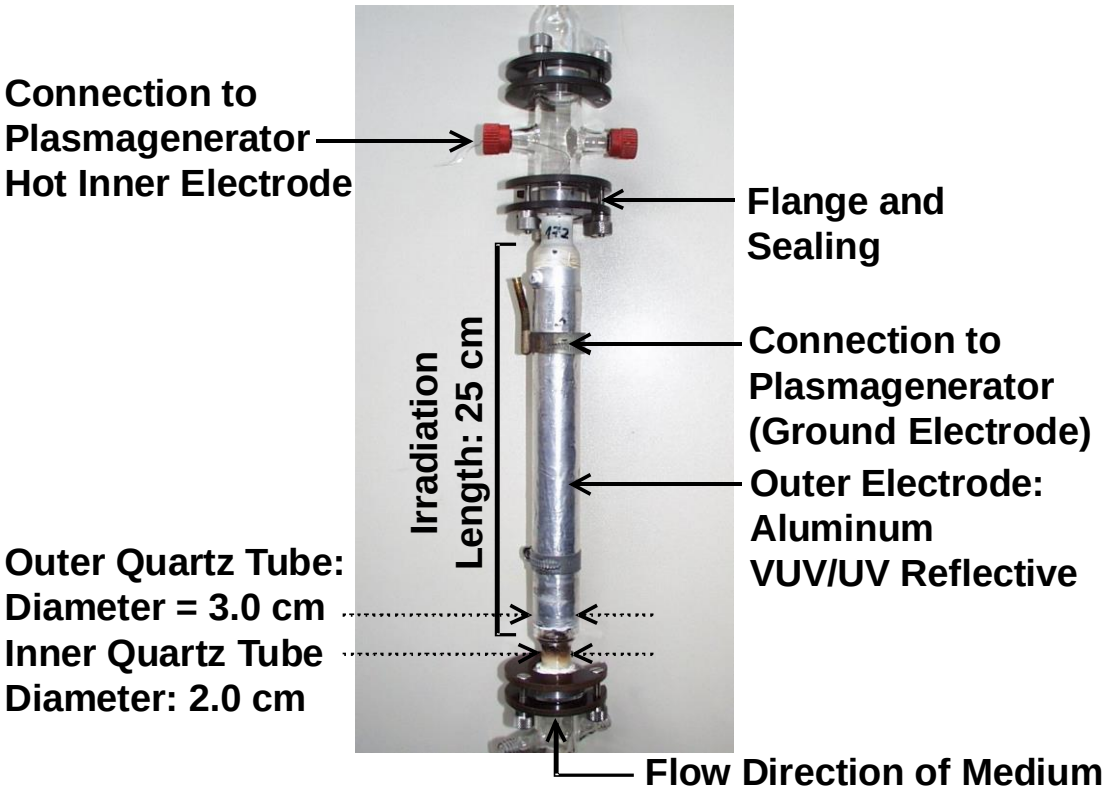

Figure 1: Excimer flow-through photoreactor (FTP, 150 W) and its dimensions.

Photochemical advanced oxidation technologies (AOTs) routinely apply mercury low-(185 nm, 254 nm) or medium-pressure (200 nm – 300 nm) lamps. However, the European Union[3a] and the World[3b] are moving constantly towards a mercury-free economy. Thus, it is obvious that the deep UV excilamps (e.g. Xe_2* 172 nm, KrCl* 222 nm, KrBr* 207 nm) will be sustaianble and eco-friendly sources of radiation for AOTs based on water, air and hydrogen peroxide photolysis. Excilamps are lamps of the future!

Acknowledgement:
In memory of Dr. Ulrich Kogelschatz who inspired and supported this work by numerous scientific discussions about DBD driven excimer lamps.

1. Kogelschatz, U., Ultraviolet excimer radiation from nonequilibrium gas discharges and its application in photophysics, photochemistry and photobiology. *Journal of Optical Technology* **2012,** *79,* 884-893.
2. Sosnin, E. A.; Oppenländer, T.; Tarasenko, V. F., Applications of capacitive and barrier discharge excilamps in photoscience. *J. Photochem. Photobiol. C* **2006,** *7* (4), 145-163.
3. a) EU Rules on Mercury in Action, doi:10.2779/791147; b) Minamata Convention on Mercury, http://www.mercuryconvention.org/