

Study of Low-Temperature Plasma Sterilization for Medical Application

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Recently, ethylene oxide gas sterilization and high-pressure steam sterilization (autoclave) have been widely used in medical sterilization. In the former case, however, it is capable of treating plastic medical instruments or wrapped materials under low temperature, say less than 70 °C, it is pointed out the toxicity and environmental issues. In the latter case, the object substances are limited to heat-resistance materials because of high temperature processing typically at 121 °C. On the other hands, in the gamma-ray or electron beam sterilization, there are some issues on cost-performance and property modification of medical instruments. Recently, it is noticed to use the low pressure or atmospheric pressure plasma discharges for low-temperature sterilization.

In the present thesis, we present the experimental results on low-temperature sterilization with non-toxic gas using low-pressure and atmospheric pressure plasma discharges. In the case of microwave discharge plasma, there are two different discharge modes classified by the microwave propagation modes; one is surface-wave plasma (SWP) and the other is volume-wave plasma (VWP). The experimental results and discussions are presented for the low-temperature sterilization using SWP and VWP. It is found that SWP can sterilize the surface of object rapidly, while VWP can treat inside the perforated plastic package by producing plasma in it. The present thesis also involves sterilization experiments using the dielectric barrier discharge and atmospheric glow discharge, and presents a useful scientific finding on the low-temperature plasma sterilization.