Purification of water-soluble cutting fluid using an air DBD plasma and its characteristic analysis

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Cutting fluids are essential for cutting performance and rust prevention in metalworking processes. Among cutting oils, the usage of water-soluble cutting fluids is increasing rapidly because they afford excellent cooling performance and ensure fire safety. However, water-soluble cutting fluids also offer a favorable environment for the growth of a wide variety of microorganisms. The growth of microorganisms can lead to various problems such as deterioration of the cutting fluids and odor generation. Thus, technologies for purifying the waste of water-soluble cutting fluids are required. In this study, we developed an ozone treatment technology that uses an air DBD plasma system. Furthermore, sterilization experiments were performed with K. pneumoniae, P. aeruginosa, E. coli, and P. vulgaris as representative microorganisms. The system offers the advantages of low power consumption and simple structure. Approximately 1000 ppm of ozone could be stably generated under optimized conditions, and the ozone was injected into the reactor as micro-bubbles for improving reactivity and inactivation rate. The sterilization experiments confirmed that the water-soluble cutting fluid was sterilized by 99.99%. As a result, the turbidity, pH, and odor of water-soluble cutting fluid have been improved.

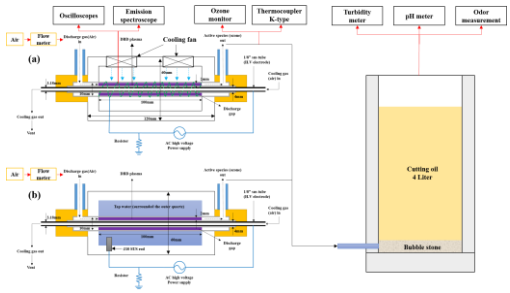
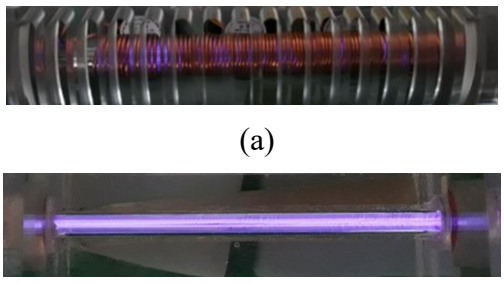


Fig. 1. Schematic drawing of the developed DBD system grounded with (a) coiled copper or (b) surrounded water for purifying waste water-soluble cutting fluids



(a)

(b)

Fig. 2. Photographs showing the stable DBD plasma from air gas grounded with (a) coiled electrode and (b) surrounded with water.

References

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