

**Microwave Discharge of Nitrogen and Oxygen Gas Mixture  
for UV Light Source**

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## Abstract

This research focuses on the study of the emission spectrum from microwave discharge of  $N_2/O_2$  gas mixture in the UV and visible range (from 200 – 800 nm) in a cylindrical quartz tube aiming to apply it as a mercury free electrode less UV light source which can be used for water purification.  $N_2/O_2$  discharge emits intensive UV light in the 210 nm to 315 nm region which has germicidal effect. We investigated the dependence of gas composition and total pressure on the intensity of the UV emission. The experimental results showed that the UV intensity in 2100- 315 nm region varies with gas composition and pressure. In the examined condition, the highest was obtained at 20%  $O_2$  concentration and 500 Pa total pressure.

In this research, experiments were carried out to study the effect of inert gases on the intensity of the emission from  $N_2/O_2$  discharge. He, Ne, Ar, Kr and Xe gases were used at different percentages of concentration. It was observed that at low concentration below 5%, these gases have no effect on the emission intensity whereas the emission intensity in both the UV and visible ranges decreased as the rare gas concentration was increased. The gases only behave as buffer gases. Buffer gases caused collisions with the other co-existing molecules and decreases the emission intensity.

Long time operation of microwave excited  $N_2/O_2$  gas mixture discharge without refreshing the enclosed gas was also conducted. To avoid degradation of enclosed molecular gases through chemical reactions with electrodes, we used electrode less microwave excitation for discharge in closed quartz discharge tubes. It was found that the intensity of NO peaks decreased with time due to the decrease of  $O_2$

concentration inside the closed tube with operation time. Within 1 hour of operation, O<sub>2</sub> concentration decreased from 20% to 5% and in the following 10 hours, O<sub>2</sub> concentration reached to almost 1%. The pressure of N<sub>2</sub> also decreased with time. After several 10 hours of operation the pressure of N<sub>2</sub> dropped to a level which is not enough to sustain the plasma.

In this study, we also estimated UV, germicidal UV and effective germicidal power density in comparison with a low pressure commercial mercury lamp (GL10). The UV (200 -400 nm) power density was 1100  $\mu\text{W}/\text{cm}^2$  from N<sub>2</sub>/O<sub>2</sub> discharge and was 180  $\mu\text{W}/\text{cm}^2$  from GL10 lamp. Power density in the germicidal range (210 nm to 315 nm) was 470  $\mu\text{W}/\text{cm}^2$  from N<sub>2</sub>/O<sub>2</sub> discharge and was 170  $\mu\text{W}/\text{cm}^2$  from GL10 lamp whereas the effective germicidal power density was 170  $\mu\text{W}/\text{cm}^2$  from N<sub>2</sub>/O<sub>2</sub> discharge and was 120  $\mu\text{W}/\text{cm}^2$  from GL10 lamp. In case of Hg lamp, 95% of the UV light is emitted in the germicidal region and 65% of the total UV light is effective in germicidal action. On the other hand, in case of N<sub>2</sub>/O<sub>2</sub> discharge 45% of the UV light is emitted in the germicidal range and only 15% of it is effective in germicidal action.

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