# ADVANCED AIRBORNE CONTAMINANT REMOVAL USING PHOTO-IONIZATION WITH CNT-BASED SOFT X-RAY TECHNOLOGY

**Wonseok Han[1], Hyungseob Park[1], Namkyu Lee[1], Seongjun Park[1],**

**Maia Czerwonka[1,2], Victoria B. M. Dias[1,3], Britney Hoang[1,3],**

**Sner Mamtora[1,3], Henry Ward[1,3], Daniel S. Joo[1,4] and Se Hoon Gihm[1]**

[1]aweXome Ray Inc., Anyang 14056, Republic of Korea
[2]University of Washington, WA 98195, USA
[3]The University of Texas Austin, TX 78712, USA
[4]Gyeonggi Suwon International School, Suwon 16706, Republic of Korea
Tel: (+82) 70-5220-0279 Fax: (+82) 2-6969-5185 Email: sehoon.gihm@awexomeray.com

**Keywords**: soft X-ray, photo-ionization, airborne bacteria, CNT cold cathode, air purification

## INTRODUCTION

There is a growing demand for air purification technology that enables safe, continuous removal of microbial and chemical contaminants including COVID-19 and H5N1. Conventional air purification technologies such as HEPA filtration and UV-C disinfection face inherent limitations including physical filter maintenance, limited microbial inactivation, and potential ozone generation. To address these shortcomings, aweXome Ray Inc. has developed a novel photo-ionization-based air purification device employing a carbon nanotube (CNT) cold cathode-driven soft X-ray source. In this study, we describe the working principles of the developed system and provide results from certified performance tests as well as field applications.

## METHODOLOGY

The CNT-based soft X-ray (<5 kV) system induces photo-ionization, imparting electrostatic charges to airborne particulate matter such as fine dust, bacteria, and viruses. The charged particles are then captured on the collection unit through electrostatic attraction. These collected particles can be removed by washing, allowing the collector to be reused semi-permanently.

Laboratory evaluations followed KOLAS-certified microbiological reduction protocols, and field validations were conducted using real-time particle counters and Volatile Organic Compound (VOC) sensors in environments such as:

- Food processing facilities (targeting mold/bacteria)
- Commercial kitchens (removal of cooking fumes and VOCs)
- Indoor shooting ranges (heavy metal gas and particulate mitigation)
- Semiconductor fab pilot areas (in conjunction with activated carbon filters)

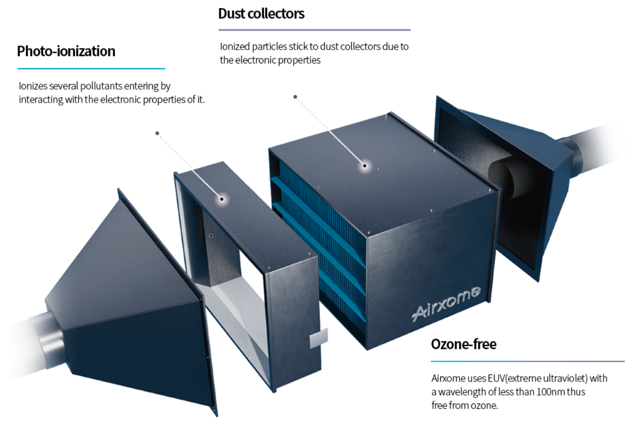


Fig. 1. Scheme of photo-ionization based air purification & sterilization system (Airxome)

## RESULTS AND DISCUSSION

Significant microbial inactivation was observed in sealed chamber tests, with over 99.9% reduction in airborne E. coli and Staphylococcus aureus within 30 minutes of operation. Field testing in a food packaging plant demonstrated visible reduction in spoilage over 5 days. In indoor kitchens, substantial VOC reductions (>80%) and odor elimination were reported. Shooting range tests showed effective removal of lead and nitrogen dioxide gases.

Unlike UV-C lamps, the device operates at room temperature, requires no mercury, and generates no ozone by-products. As the system contains no consumable filters, it provides long-term economic advantages in industrial applications.

Fig. 2. Ref. Samsung Electrics R5 Campus


Fig. 3. Ref. Kkotsooni Kimchi

## CONCLUSION

This study demonstrates the efficacy of a soft X-ray-based, CNT-driven photo-ionization system for airborne contaminant removal. Its filterless, ozone-free, and energy-efficient operation positions it as a promising alternative to traditional air purification technologies. Current limitations such as production cost are being addressed through upcoming mass manufacturing efforts. The technology holds potential in diverse sectors, particularly those sensitive to microbial contamination and volatile gases.