A Report on Gaseous Plasma for Air Disinfection

By Dr. Kimberly Crawford, MD, and Robert Lin, EE,

Gas Plasmas have existed since the beginning of time - long before the advent of solids or liquids. In fact, 99% of the universe is plasma. When energy is applied to a solid, it becomes a liquid. Apply more energy to a liquid and it becomes a gas. If further energy is applied to a gas, it then becomes plasma. Gas Plasma consists of dissociated molecules, ions, free radicals, and elements of such entities at an elevated state of energy. When matter is described as above, it cannot be truly described as a gas, liquid or solid. It is therefore described as the "fourth state" of matter – plasma.

Plasmas are used today for a variety of commercial applications ranging from microelectronic technology, to electron and ion beam projection lithography, to materials processing, to flat panel displays, to toxic waste treatment. This report explains the use of plasmas for neutralizing or removing contaminants in indoor environments.

There are several manufacturers of air purification devices that are utilizing advanced plasma technology for removal of airborne and surface contaminants. These devices use a variety of sources of energy to produce plasma. One particular device studied, the Biozone Air Purifier, uses high intensity ultraviolet light to energize gas. The result is an oxygen plasma containing O+, O-, O_2, O, O_3, ionized O_2, metastable excited O_2, and free electrons. In addition, photons from the UV region have enough energy to break the carbon-carbon and carbon-hydrogen bonds in organic pollutants with the result being degradation of the pollutant. Plus, hydrogen atoms from these processes as well as from humidity in the air combine with oxygen species creating highly active radicals that are ideally suited for the oxidation of contaminants and disinfecting of air and surfaces.

The results of testing on biological contaminants as well as other organic pollutants revealed dramatic reductions in both from the plasma produced with the Biozone Air Purifier. It is most important to note that plasma-producing devices are different than just ultraviolet light air purifiers and different than ozone generators. Typical germicidal ultraviolet lightwaves are not of sufficient energy levels to create plasmas. Ozone generators generally produce copious amounts of O_3 without the other necessary elements required for a plasma production. While there is ozone contained in oxygen plasmas, it is not of the level produced by ozone generators and should not be confused with such. What separates plasma-producing machines used for air purification from ozone generators is that the other plasma ingredients are so much more powerful in reducing contaminants that little ozone is needed for that purpose. Plasmas are a safer alternative.