**Project ID:** 54973

**Project Title:** A Novel Energy Efficient Plasma Chemical Process for the Destruction of Volatile Toxic Compounds

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## Research Objective

The objective is to develop a novel plasma chemical process for the destruction of low-concentrations (below several percent) of toxic volatile compounds from contaminated air streams. Such contaminated air streams are encountered in air stripping of highly-contaminated water and soil, and also in the incineration of combustible hazardous wastes. Our technique is based on the efficient dissociation of molecules via enhanced electron attachment to highly-excited states of the molecules produced in a glow discharge.

## Research Progress and Implications:

This project was based on enhanced electron attachment to highly-excited states of molecules observed in laser excited molecules. The basic idea was to achieve molecular excitation using a glow discharge. We have conducted basic studies to illustrate that enhanced electron attachment to highly-excited states can be achieved using both continuous (Refs. JP1,JP3, JP7) and pulsed discharges (Refs. JP2,JP10, JP12). A discharge reactor was constructed and analytical methods were developed to measure the destruction efficiency (Ref. JP8). Plasma remediation experiments were conducted using both continuous (Refs. JP4) and pulsed (Refs. JP11,JP14) discharges using inert gases as the carrier. Furthermore, basic studies were conducted (Refs. JP5,JP6, JP7, JP9, JP12, JP13) in order to clarify the destruction efficiencies observed in the reactor. These studies confirmed our basic idea, and also led to a serendipitous outcome, i.e., the reactor output was free of hazardous gaseous byproducts. In our studies on benzene and methylene chloride, dust particles were observed to accumulate in the reactor. We have conducted several studies to characterize the dust particles produced in a benzene discharge, and they were identified as carbon nanoparticles.

## Planned Activities:

If the project is to be continued, we plan the following main activities:

1. We propose to test whether the same destruction characteristics hold for other toxic compounds of interest to DOE such as trichloroethylene, carbon tetrachloride, and dioxin.
2. Characterize the dust formed from other pollutants (especially chlorinated compounds) to test whether they have any undesirable properties. The production of nanoparticles in the destruction process may also have commercial value.
3. Conduct studies on the above listed toxic gases in mixtures with air, to determine whether the output will be free of hazardous gases, and whether the dust formation still holds. We have already conducted studies in $N_2$ mixtures which have shown that dust formation still occurred. We propose to add $O_2$ and water vapor in their representative concentrations to investigate their influence.

**Information Access:**

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