Project ID: 55328

Project Title: Novel analytical techniques based on an enhanced electron attachment process

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Number of Graduate Students: 1

Research Objective:

The objective of this research program is to develop new analytical techniques based on the large cross sections associated with dissociative electron attachment to highly-excited molecular states. Such highly-excited states can be populated by using fixed frequency lasers or in glow discharges via excitation transfer from high-lying, metastable states of rare gases. It is anticipated that these studies will lead to negative-ion based analytical techniques for the detection of DNAPLs (dense non-aqueous phase liquids), VOCs (volatile organics) and other toxic compounds at DOE waste sites. We have made significant advances toward this goal as described below.

Research Progress and Implications:

We have pursued the development of (i) laser based, and (ii) glow discharge based analytical techniques, and have conducted studies to elucidate the basic mechanisms and to move the project closer to field applications. We have illustrated that long lived core-excited high-Rydberg states can be produced using fixed frequency lasers (JP1, JP4, JP12) and glow discharges (JP2, JP3, JP13), and that efficient negative ion formation can be achieved using lasers (JP5,JP11) and glow discharges (JP6,JP8,JP10). Electron attachment mechanisms were clarified (JP5, JP7, JP9, JP12, JP14). We have built a solid

foundation for the development of novel laser and glow discharge based analytical instruments.

Planned Activities:

If the research grant is renewed, we plan to achieve the following goals:

1. Optimize laser-induced negative ion formation by incorporating an electron gun.
2. Collaborate with Comstock, Inc in Oak Ridge to build a portable laser based mass spectrometer that can function in both negative and positive ion modes.
3. Incorporate a quadrupole mass spectrometer to the plasma apparatus for mass analysis.
4. Build a novel electron capture detector based on the glow discharge excitation scheme.

Information Access:

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Patent:

L. A. Pinnaduwage, AA Novel Glow Discharge Process for Analytical Applications,@ Patent No. 5,896,196 (1999).