

INTRODUCTION

Electrospray ionization mass spectrometry (ESI-MS) is a method of mass spectrometry in which high voltages are applied to a dissolved sample to produce gaseous ions.

ESI-MS is a form of “soft” ionization that preserves large biomolecules. It is ideal for analyzing extraterrestrial samples for evidence of life. *However, current ESI-MS methods rely on a pressurized environment.*

OBJECTIVE

Modify ESI-MS for vacuum conditions for use on spacecraft at icy moons and other areas of solar system.

BACKGROUND RESEARCH

Many space probes, including the mass spectrometer on the Cassini mission, could not accurately categorize large organic molecules due to incompatibility. Using ESI-MS would fix this issue as is tailored to large organic molecules.

RELATED RESULTS

- [American Chemical Society, 2017](#)
 - Successful vacuum operation of ESI-MS achieved with pulses of air
- [Pacific Northwest National Laboratory, 2008](#)
 - Successfully decreased ESI-MS operating pressure to 30 millitorr

Designing Instruments to Detect Life with OASIS

(Organic Analysis System utilizing Ion Sprays)

Developing a new technique for detecting molecules in the solar system.

The above animation follows the ESI-MS process as it would be used in a space mission.

PLANNED EXPERIMENTS

Variable	How are we changing it?
Solvent	Test low volatility, ionic liquids
Capillary Tube Geometry	Reduce diameter to control cluster size
Buffer Gas	Reduce flow rate to zero
Temperature	1. Liquid in capillary; 2. Downstream capillary transferring stream to detector

PLANNED SIMULATIONS

We will develop a computer simulation of an electrospray ion source in space to explore the effects of eliminating the buffer gas and changing the solvents.

The model will use existing code that tracks the trajectories of charged particles in the presence of electric fields in vacuum, accounting for the break-up of large ion clusters to determine the state of the particle as a function of time and space.

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