Development of an APPIS-IMS Instrument for space applications

Luther W. Beegle[1], Brett Beckett[2], Ernest Ryu[3], Hugh I. Kim[1], Isik Kanik[1]

[1]*Jet Propulsion Laboratory*
[2]*New Mexico State University*
[3]*California Institute of Technology*

Ion mobility spectroscopy (IMS) is an effective technique for detecting organic compounds in a sample. In order to detect a sample using an IMS, the molecule must undergo ionization. However, current ionization processes pose a significant challenge in utilizing IMS for an outer-space mission. An outer-space instrument must be low mass, small volume, and power efficient. Current lab based ionization methods fail to adhere to these criteria. To solve this problem JPL has been researching a new Ambient Pressure Pyroelectric Ion Source (APPIS) system. APPIS is a compact, low-power ion source that utilizes the characteristics of a pyroelectric crystal. When a sharp temperature gradient is applied to the crystal, electrical discharge occurs at the surface of the crystal. This discharge ionizes compounds on and near the surface of the crystal. Our aim is to utilize this effect for IMS by controlling the temperature gradient of the crystal with a Peltier module system. A Peltier module utilizes the thermoelectric-Seebeck effect to create a temperature difference between the front and back surfaces of the module. When two of these modules are used, the crystal can be heated and cooled causing constant ionization. This method meets the criteria listed previously. The APPIS system integrated with an IMS is suitable to obtain reliable and accurate data in harsh environments.