Ground-based simulation of Enceladus fly-through plume sampling and analysis using ultra-low density aerogel

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Understanding the variety and the distribution of the building blocks of life in space is one of the important scientific themes for Astrobiology. *In situ* detection of organic molecules from extraterrestrial bodies thus provide insight into ongoing chemical evolution of building blocks of life, and possibly the detection of extraterrestrial life itself. Here we conducted a ground-based simulation of Enceladus fly-through plume sampling, extraction and analysis of two simple organic molecules, Glycine (Gly) and Glycyl-L-alanine (GlyAla) dipeptide. Hypervelocity impact experiment was carried out at JAXA/ISAS using pure Gly and GlyAla crystal as well as freeze-dried sample of 10% w/w organic-NaCl mixture. Approximately 5 mg of powder samples are placed into sabot projectile and accelerated to a speed of 4-6 km/sec and captured by ultra-low density (10 mg/cc) hydrophobic and hydrophilic silica aerogels. Aerogels with impact tracks are transferred to order-made aerogel container made of space compatible material polyetheretherketone (PEEK) and soaked by 5 ml 75% acetonitrile water solution for sufficient diffusion of organic molecules. Extracted solution was freeze-dried and resuspended in 100 μl water and analyzed using LC-QTOF-MS. So far, we have obtained LC profile/MS spectra corresponding to intact GlyAla from both hydrophobic and hydrophilic aerogel with sample recovery rate of approximately 0.1%. Ongoing analysis will further provide information on Glycine as well as degree of impact-driven organic alteration to demonstrate the capability ultra-low density aerogel for analysis of astrobiologically-relevant organic molecules in future spaceflight missions.

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