Designed for space travel, new device can collect, analyze liquid as it passes by planets

11 July 2019

Purnendu “Sandy” Dasgupta, Hamish Small Chair in Ion Analysis in the UTA Department of Chemistry and Biochemistry and adjunct Professor in the departments of Physics and Electrical Engineering. Credit: UTA

A chemist at The University of Texas at Arlington has engineered a device capable of collecting drops of liquid as it travels through space and analyzing their content for conditions that support life.

Purnendu "Sandy" Dasgupta, Hamish Small Chair in Ion Analysis in the Department of Chemistry and Biochemistry and adjunct Professor in the departments of Physics and Electrical Engineering, created an instrument platform called open-tubular chromatography to detect and separate ions.

Dasgupta's new method, designed for space travel, uses small volumes of liquid samples injected into tubes that are one-fourth the diameter of the finest human hair. He said his instrument can analyze and present results on a single drop of liquid while flying through or by the atmospheres of other planets and moons.

"There are fundamental incompatibilities between how one measures key ions in an Earth-bound lab and what NASA needs us to do in space," Dasgupta said. "We had to devise a method to detect and separate ions that uses very little power and does not take up too much space. Every little bit of weight, volume and power is expensive when traveling to another planet."

The project was supported by almost $1 million from NASA through a Planetary Instrument Concepts for the Advancement of Solar System Observations, or PICASSO, grant. Dasgupta has received an additional $1.4 million Maturation of Instruments for Solar System Exploration, or MatISSE, grant from NASA to continue to strengthen the instrumentation and prove it can withstand the harsh conditions and lengthy travel times of space exploration.

"The MatISSE phase focuses more on engineering and proving the robustness of the equipment and is less about the possibility of new discovery than in the PICASSO stage," Dasgupta said. "But it is vital nonetheless. We have to ensure the instrument can reach a site after a journey of several months or years and still perform if we want it to take up a valuable spot on a spacecraft."

While there is an immediate focus on Mars for exploration, Dasgupta said the open-tubular chromatograph has the potential for analysis at sites that require five or more years of travel to reach.

Morteza Khaledi, dean of the UTA College of Science, said Dasgupta's ability to develop technology that withstands the hostile environments of space is an impressive feat.

"To miniaturize the open-tubular chromatography

system to this extent, Sandy had to devise innovative engineering and analytical techniques that not only have potential for important discoveries outside of our planet, but also implications for revolutionizing the way we conduct this kind of science on Earth," Khaledi said. "I applaud Sandy for the way he reaches across boundaries to answer questions and thank him for his visionary work."

Dasgupta's research portfolio showcases his expertise in chromatography and his ability to solve complex problems, said Duane Dimos, vice president for research.

"Sandy's research is innately purpose- and outcome-driven," Dimos said. "UTA has a distinguished history of working with NASA, and Sandy is continuing that tradition by creating a vital tool that can help answer one of our greatest longstanding questions. He and his team of students represent a unique way of multidisciplinary thinking to overcome obstacles. I am grateful to see them contribute mightily to NASA's mission while enhancing scholarship at UTA."

Dasgupta has received numerous national and international honors for his work in recent years, like earning the Talanta Medal and being named to the Power List by The Analytical Scientist Magazine. He was selected as the 2018 Distinguished Texas Scientist by the Texas Academy of Science and the recipient of the 2018 American Chemical Society's Division of Analytical Chemistry Chemical Instrumentation Award.

Recently, one of his papers was identified as one of the 10 most influential papers published in 2018. This is the second consecutive year he has received this honor.

Dasgupta said his achievements would not be possible without the UTA students who work in his lab and pursue their own problem-solving research. He said he is fortunate his peers recognize his work.

"I'm thrilled that I've been able to spend most of my life playing in laboratories and answering questions," Dasgupta said. "I'm grateful people have found enough meaning in that to fund my work and allow me to keep playing. What could be better?"

Provided by University of Texas at Arlington