Title tells what the method/tool does (senses amino acids) and highlights the major benefit (portable).

Objective of the project is explicitly stated (but could have used a more informative header).

Figures are used to explain the necessary background and problem.

Room for improvement:
By writing this information as a concise bullet point list, the reader will not be overwhelmed by this "wall" of text.

Figures and a flow chart show the major tool development stages and do not overwhelm the audience with too much information.

National Aeronautics and Space Administration

Development of a portable in-situ biosensor for amino acid characterization

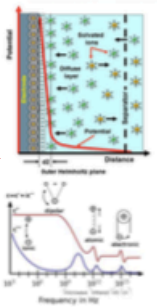
Principal Investigator: Keith B. Chin (3463)
Jessica Creamer (389), Ike Chi (3462), Jasmina Pasalic (3463), Chen-kuo Huang (3462)
Program: Spontaneous Concepts

Listing PI first is a formatting requirement for this JPL poster session.

Project Objective:

Finding evidence of life or extant life is the primary goal of JPL future missions to planets such as Mars, Europa, and Enceladus. Therefore, there will be a critical fundamental need for portable low power instruments capable of life detection at the microscopic level in local extreme environments in spacecraft such as landers, rovers, and micro-bots.

The focus of this project is the development of portable in-situ biosensors for amino acid characterization using the technique of electrochemical impedance spectroscopy (EIS). As shown in the adjacent figure, an impedance sweep over a wide frequency range can produce many representations of electrical properties associated with molecular transport and relaxation processes near charged interfaces. These electrical properties can enable detection on the smallest of differences in chemical and physical behavior of analytes such as amino acids.



Interfacial Molecular (top) vs. Measurement (bottom) depictions

FY15/16 Results:

Experiential Method: **We developed a setup of incorporating various polarizable micro-electrode configurations to perform *in-situ* EIS. This provides significant life-time and detection advantages:**

- **Detects spatial and temporal response emanating from molecular interactions.**
- **Mitigate issues with cross-selectivity and measurement stability over time.**
- **Enables non-intrusive handling & preparation of samples.**
- **Offers versatility/scalability in many forms of deployment platforms.**

Experimental Results: **Using various representations from EIS measurements (complex impedance, conductivity, relative permittivity, etc.), sensitivity down to ppb concentrations was demonstrated in liquid water. Modified surface electrodes can further enhance both sensitivity and selectivity. In this work, we have developed a working impedance model to physically describe the bulk and interfacial properties associated with microscopic physical behavior from measurements results. Extracting relaxation time constants, polar vs non-polar amino acids were easily distinguished.**

Future Works: **Performing characterization on realistic mixtures of amino acids over a wide temperature range on various water phases (liquid/ice).**

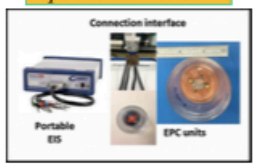
Benefits to NASA and JPL (or significance of results):

Development of portable in-situ biosensors will enable microscopic detection and characterization of prebiotic materials and processes in various local environments such as ocean and icy worlds. The versatility of deployment platforms of the proposed instrument is paramount in next-generation smaller, low power spacecraft.

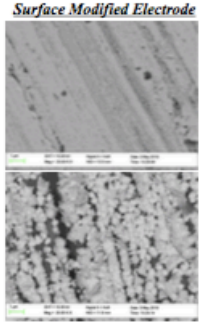
Major project achievements are concisely explained in a bullet point list using active verbs.

Room for improvement:
Whitespace could be used to separate methods, results, and future works to improve readability.

Experimental Method

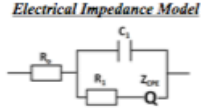


Surface Modified Electrode



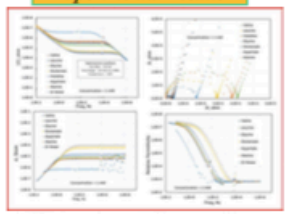
Scientific Basis – Amino acids have sufficient uniqueness in chemical and physical properties in aqueous environments to enable detection.

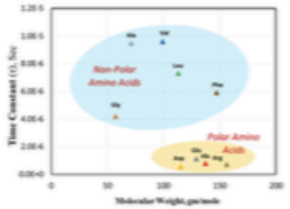
Electrical Impedance Model



$$Z(\omega) = R_0 + \frac{R_1 + Z_{CPE}}{j\omega C_1 (R_1 + Z_{CPE}) + 1} = R_0 + \frac{1 + R_1 T (j\omega)^n}{j\omega C_1 + R_1 C_1 T (j\omega)^{n+1} + T(j\omega)^n}$$

Experimental Results





Future work is explicitly stated.

Publications:

•K.B. Chin, I. Chi, J. S. Creamer, J. Pasalic, and C-K Huang, "Development of a portable in-situ biosensor for amino acid characterization" **NTR NPO-50337.**
•K.B. Chin, I. Chi, J. S. Creamer, J. Pasalic, C-K Huang, and L. M. Barge, **"Electrochemical characterization of amino acids using micro-electrode impedance spectroscopy"**, *Astrobiology*, pending.

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