Electrochemical Detection of Biological Catalysts as Signatures of Extant Life. J. E. Koehne, NASA Ames Research Center, Moffett Field, CA 94035 [Jessica.E.Koehne@nasa.gov]

Introduction: Liquid water is the quintessential ingredient for life. Biochemistry as we know it is not possible without it. There are two places in the Solar System, other than the Earth, where liquid water is known to exist: Europa and Enceladus. Cassini's recent discovery of Enceladus' ocean plumes has excited the scientific community about the possibility for liquid sampling and search for life. Characteristics of life are self-sustainability, its ability to evolve, and self-enclosure [1]. To enable these, chemical energy must be utilized, information must be stored, and enclosing membranes must be built. Many of these processes are accomplished with the use of biological catalysts. To search for life in the ocean worlds, detection of biological catalysts serves as a strong marker of biological activity and thus life.

Approach: Miniaturized chemical and Biochemical sensors and sensor arrays offer some of the most promising approaches to in situ planetary exploration including small-payload investigations, large class robotic missions and human space exploration. At NASA ARC, we have leveraged the basic Wet Chemical Laboratory (WCL) design from the Mars Phoenix Lander to perform additional analysis of biological targets. The overall objective is to develop new sensor-based technologies to enable bio-exploration and life detection during future missions to our solar system's icy worlds.

We have developed one such sensor technology to detect the evidence of biological catalysis. In particular, the serine protease trypsin has been chosen for a proof of concept due to its abundance in Earth-based life. Typsin catalyzes the break down of proteins through a catalytic triad consisting of histidine, aspartate and serine. Gold sensing electrodes are functionalized with probe peptide sequences labeled with a redox active reporter. Upon introduction of trysin, the redox-active tag is cleaved from the peptide and thus from the sensing electrode. The characteristic redox signature of the redox-active tag is detected using square wave voltammetry. Decreases in redox current is measured and attributed to cleavage by trypsin.

This biological catalyst sensor is one example of an expansion of the WCL platform for the search for extant life.

References: [1] Benner, S. A., (2010) *Astrobiology*, 10, 1021-1030.