### **Proposal: Detection of Biosignatures on Mars Using a Combination of Spectroscopy and Electrochemical Sensors**

#### **1. Introduction:**

Mars is one of the most promising planets in our Solar System for the potential existence of life. The iron oxide present on the Martian surface, which gives the planet its characteristic red color, may also carry traces of biological processes. Additionally, the presence of phosphate minerals on Mars, formed through both magmatic and aqueous processes, could serve as an indicator of past life on the planet.

**Article Excerpt:**"The presence of phosphates on Mars serves as a crucial indicator of the planet's geological and potentially biological history. These minerals, which can form in both igneous and aqueous environments, are essential in understanding the past presence of water and the potential for life on Mars."

The aim of this proposal is to review existing knowledge regarding the search for life on Mars and to present a new research approach. This approach focuses on utilizing advanced spectroscopic techniques for detecting biosignatures on the Martian surface. Specifically, we will explore the application of laser-induced breakdown spectroscopy (LIBS) for nitrogen detection, phosphate mineral analysis, and the role of biotechnological applications in supporting Mars colonization efforts.

#### **2. Literature Review and Discussion:**

**2.1. Article 1: Assessing the Feasibility of Laser-Induced Breakdown Spectroscopy for Detecting Nitrogen in Martian Surface Sediments**

This article evaluates the feasibility of using LIBS to detect nitrogen on the Martian surface. Nitrogen is a fundamental element for biological processes, and its presence on Mars is crucial for assessing the planet's habitability. The study shows that LIBS can detect nitrogen even in low concentrations on the Martian surface sediments.

**Article Excerpt:**"The detection of nitrogen in Martian surface sediments, even at low concentrations, is crucial for assessing the planet's habitability potential. The LIBS technique, with its high sensitivity, offers a promising method for such detections, providing insights into the presence of essential elements that support life."

**Relevance to the Proposal:**Detecting nitrogen, a key bioelement, is vital in the search for life on Mars. Therefore, this research proposal focuses on using the LIBS technique to investigate nitrogen concentrations on the Martian surface, which is critical for understanding whether biological activity, past or present, exists on the planet.

**2.2. Article 2: Biological In-Situ Resource Utilization (BISRU) for Mars — Merging Planetary Science, Space Biology, Microbial Ecology, Agriculture**

This article explores biological approaches to in-situ resource utilization (ISRU) on Mars. BISRU aims to produce essential resources like water, oxygen, and food through biological processes, leveraging microorganisms and plants. This approach is essential for sustaining life on Mars and reducing dependency on Earth-based resupply missions.

**Article Excerpt:**"The integration of biological in-situ resource utilization (BISRU) with Mars colonization efforts offers a sustainable approach to life support on the planet. By leveraging microbial and plant-based systems, essential resources such as water, oxygen, and food can be generated locally, reducing the dependency on Earth-based resupply missions."

**Relevance to the Proposal:**Sustaining life on Mars requires producing vital resources locally, such as water, oxygen, and food. Therefore, this research proposal aims to study the impact of BISRU techniques on detecting biosignatures, which could determine whether sustainable living on Mars is possible.

**2.3. Article 3: Phosphates on Mars and Their Importance as Igneous, Aqueous, and Astrobiological Indicators**

This article focuses on the significance of phosphate minerals on Mars. Phosphates can form through both magmatic and aqueous processes, providing important information about Mars's geological history and potential astrobiological indicators.

**Article Excerpt:**"The presence of phosphates on Mars serves as a crucial indicator of the planet's geological and potentially biological history. These minerals, which can form in both igneous and aqueous environments, are essential in understanding the past presence of water and the potential for life on Mars."

**Relevance to the Proposal:**Phosphate minerals on Mars are crucial for understanding the planet's past water presence and potential biological processes. This research proposal aims to investigate the distribution of these minerals and their relationship to biosignatures, helping to better understand the possibility of life emerging on Mars.

#### **3. Advanced Discussion and Conclusion:**

**A New Technical Combination:**

* I propose the development of a novel method for detecting biosignatures on Mars by combining LIBS with electrochemical sensors. This combination would allow for simultaneous detection at both macroscopic and microscopic levels, providing a more comprehensive examination of potential biological traces on Mars.

**Scientific Contribution:**

* This research will introduce a new dimension to existing technologies in the search for life on Mars. The proposed method could be applied not only on Mars but also on other planets, expanding the scope of astrobiological research.

**Potential Applications:**

* If successful, this technique could be used in future manned missions to Mars, aiding in the establishment of permanent life on the planet.

#### **4. References:**

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