Remote Sensing Elemental Composition Analysis Technology for Analysis of Microorganisms in Outer Space

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ABSTRACT

The search for extant life on Mars or other planetary bodies depends on remote sensing technique and detection of biogenic biomarkers, on the basis of sources of solar, chemical or radioactive energy. Nano-scale vibration sensors can also be used for remote sensing and detection of microorganisms. The authors present in this communication design considerations for extant life remote sensing applications.

(Keywords: extant life, Mars, remote sensing, biomarkers, nano-scale vibration sensors, microorganisms)

INTRODUCTION

The possibility of prokaryotic and microscopic life, particularly on celestial bodies such as Mars and the moons of Jupiter is a largely explored field of space research. A promising area of interest are the subsurface regoliths, polar ice caps along with regions characterized by surface frost and water ice glaciers, particularly because the presence of water in itself, is known to be key to life, although there are several hypotheses suggesting the feasibility of extraterrestrial extant life with a source of energy and stable environmental conditions alone. We hereby describe a novel remote-sensing probe and design considerations for its use in celestial topographies and climate conditions.

Remote Sensing Probe

Traditionally, remote-sensing techniques rely primarily on elemental composition analyses for identification of biomarkers that can discriminate the presence of microorganisms. One concern is that the use of Earth's signature of life criteria for Mars and other celestial bodies are limited.

We have previously described the use of soil sampling with nano-scale vibration sensors for remote sensing and on-site detection of micro-organisms [1]. This technology utilizes nano-vibrations created by the metabolic activities of microorganisms to detect the presence of life. It additionally allows for the combination of dynamic and chemical information to identify and characterize life. Moreover, its application extends from regolith and rocks to ice and permafrost, which means it has the potential to identify life in close proximities and within the polar regions of Mars.

Design Considerations

With the geographical distinctions characterizing the polar ice caps and glaciers however, it is essential for us to make several modifications to the existing technology. First and foremost, the technology should be resistant to malfunction in colder temperatures. This can be achieved through the use of thermally protective material in design. Reinforced carbon-carbon, LI-900 silica ceramic coating, and insulation tiles are examples of materials which can be utilized for this thermal protection.

Our group has also previously examined design considerations for motor units of space probes and unmanned aerial vehicles for use in Mars missions [2]. We would like to extend these considerations for remote-sensing probes as well. These considerations include:

(i) power considerations,

(ii) high climb and loiter speed,

(iii) data-link bandwidth capabilities.

(iv) navigation,

(v) rotor use in Mars' gravitational field, and

(vi) emergency considerations including loss of contact with ground control.

CONCLUSION

The search for extant life on Mars critically depends on the mapping of life-sustaining environmental niches. These niches can be identified by sensing biogenic biomarkers, on the basis of sources of solar, chemical or radioactive energy, and based on historical evidence using USGS data. Furthermore, there are existing regions in the Martian geography, which have already been mapped abundant with these biomarkers, which are promising for future explorations.

REFERENCES

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