Molecular Recognition Sensing Materials within Operational and Mission Environments for Planetary Exploration: Consideration of Stability and Robustness.

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The question of life elsewhere in the Universe is central to the discipline of astrobiology. *In situ* exploration for past or present life in candidate locations within the Solar System is envisaged via a number of proposed missions to locations such as Mars and Europa.

An approach to identify life is via (i) detection of molecular evidence of past or present life in the form of organic molecular biomarkers together with (ii) an understanding of the contextual abiotic organic environment in which biomarkers may be found. The latter is also of interest in the exploration of other bodies such as comets and asteroids.

For environmental and medical applications on Earth that desire *in situ* detection and characterisation of trace organic markers, molecular receptor based sensor technologies are receiving much attention. The current trends of multi-analyte sensor arrays, µ-fluidic and µ-system approaches, and transducer readout technology development is making remote analytical systems for astrobiology and planetary exploration a realistic practicality. A number of instrument concepts for planetary exploration have been proposed including MASSE, MoBiLD and SMILE.

Such "biosensor" technologies rely fundamentally upon the integration of molecular receptors into devices to recognise and bind complementary organic molecular targets of interest. Such sensors can exploit a wide range of molecular recognition materials with key examples being (i) proteinaceous antibodies and their various recombinant derivatives and (ii) artificial molecular recognition materials such as wholly synthetic molecular imprinted polymers (MIPs).

The operational and mission environments for an anticipated Martian mission offer a considerable challenge for the use of "fragile" molecular recognition materials due to the diversity of extreme environments that are encountered. The following summarise the key components: (i) acoustic energy – *e.g.* during launch, (ii) sterilisation – *e.g.* gamma radiation, thermal baking, chemical, H_2O_2 plasma, *etc*., (iii) thermal – both cycling and extreme excursions, (iv) extended storage times including pre-launch, (v) radiation – both particle and gamma radiation from Solar and cosmic sources and (vi) chemically aggressive sample matrices.

For many of the preceding environments, little testing of molecular recognition materials has been previously performed. This presents a significant deficiency in the current knowledge required to allow appropriate early systems level consideration of future missions.

We have initiated a series of studies to explore the stability of molecular recognition materials in a variety of operational and mission simulations and will report on the latest findings.

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