Manipulation of Samples in Mini Environments

P. Mani, tecrisk GmbH, Gryphenhübeliweg 34, 3006 Bern, Switzerland (pm@tecrisk.com).

In an extra-terrestrial mission – e.g. to Mars - aimed at bringing back samples, two aspects must be considered: First, planetary protection, which basically corresponds to biosafety measures depending on the classification of the mission and second sample protection. While the first issue is much easier to take care of, the second is extremely difficult.

Using 10 g for the detection of organic molecules and assuming that we are able to detect femtograms of organic material then the maximal acceptable contamination of the sample should be below 10-7 ppb only! This is an extremely low contamination, as only minute pieces of abraded material from any container would cause severe problems.

The micro-world and the nano-world are different from the macro-world. Effects negligible at the macroscopic level become important at the micrometre scale, and vice versa. With this, it becomes obvious that material properties play a very important role in the design of manipulators for very small samples like e.g. dust particles.

The two main challenges in robotics are to ensure a clean and sterile environment so that the manipulator does not contaminate the samples and to ensure precise tele-operation of the manipulator.

Risks of biohazard and sample contamination are analysed and discussed in the frame of requirements for a European **E**xtra-terrestrial **S**ample **C**uration **F**acility (ESCF).

References: P. Mani et.al., MSRF Summary Report, ESA February 2012.

Keywords: Containment, Mini-Environment, Microrobotics, Sample manipulation