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18. Abstract

In the last few years Raman spectroscopy has been identified as an advanced method for in situ planetary analysis. The most important fields that Raman spectroscopy is addressing are the mineralogical and organic/biological analyses on micrometer size scale.
Thinking about the realisation of a Raman instrument for planetary observations, the driving design constraints are the limited resources on those missions like power, mass and instrument envelope. From the measurement point of view the main design driving constraint is caused by the weakness of the Raman signal itself, which is in the order of 10^{-8} referred to the stimulating light input.
In this breadboard study two different approaches have been followed to define appropriate concepts for a space born Raman instrument. The two presented instrument concepts differ mainly in the spectrometer part. The first bases on an AOTF (Acusto-Optic Tunable Filter) in combination with an APD detector, the second approach uses an improved Hadamard spectrometer with CCD detector.
Measurements with the breadboard heve been carried out to collect specific instrument data for further concept improvements. Preliminary assessments show that a Raman instrument with a total volume of 150x150x150mm³, a total mass of less than 2kg and a power consumption of less than 10W is feasible.

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Planetary Research, MIRAS, Raman Spectroscopy

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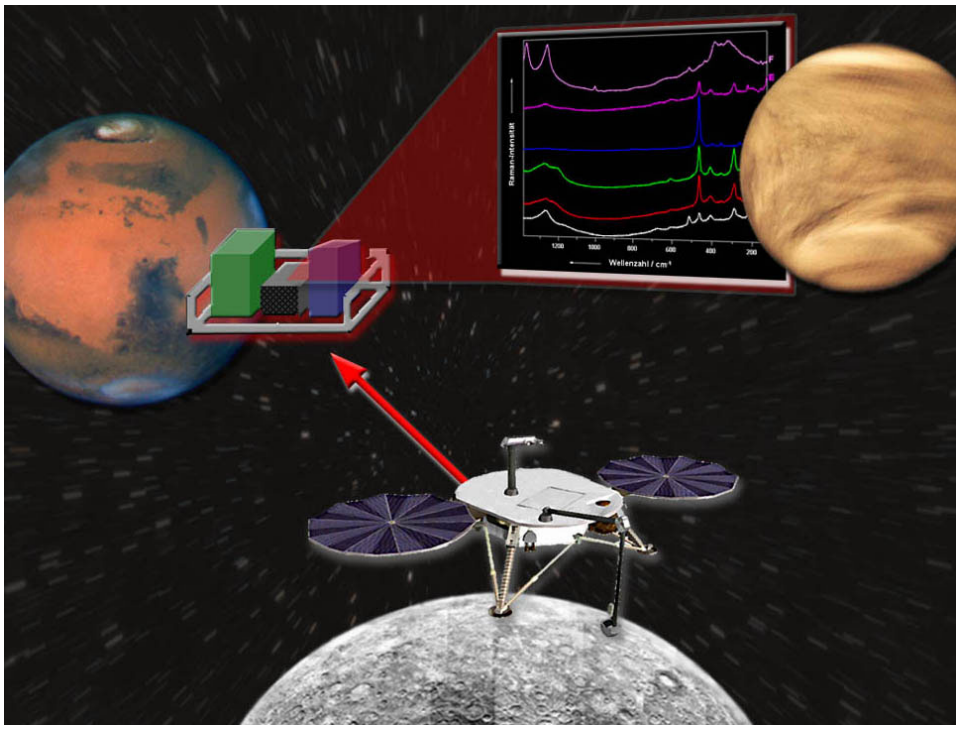
MIRAS

Mineral Investigation by in situ RAMAN Spectroscopy



Study Report

FKZ 50 OW 0103

CONTENTS

ANNEX A-1

1 INTRODUCTION

1.1 Scope

This document summarizes the results of the concept study for the instrument MIRAS, i.e. an instrument for Mineral Investigation by in situ RAMAN Spectroscopy, to be applied for future planetary missions. As baseline to derive mission relevant instrument requirements the proposed ESA Bepi Colombo Mission to Mercury has been taken into account.

1.2 Applicable Documents

AD1 Bepi Colombo ESA Mission Report ESA-BR-165, Sept. 2000

AD2 Bepi Colombo System and Technology Study Report, ESA-SCI (200)1, April 2000

1.3 Reference Documents

RD1 Cooney, T. F.; Scott, E. R. D.; Krot, A. N.; Sharma, S. K.; Yamaguchi, A, Vibrational spectroscopic study of minerals in the Martian meteorite ALH84001. *American Mineralogist* **(1999),** 84(10), 1569-1576.

RD2 Dickensheets, David L.; Wynn-Williams, David D.; Edwards, Howell G. M.; Schoen, Christian; Crowder, Chelle; Newton, Emma M., A novel miniature confocal microscope/Raman spectrometer system for biomolecular analysis on future Mars missions after Antarctic trials. Journal of Raman Spectroscopy (2000), 31(7), 633-635.

RD3 Edwards H. G. M., Farwell D. W., Grady M. M., Wynn-Williams D. D., Wright I. P. **(1999)** Comparative Raman microscopy of a Martian meteorite and Antarctic lithic analogues. *Planet. Space Sci.* , **47(3/4)**, 353-362.

RD4 Gasharova, Biliana; Mihailova, Boriana; Konstantinov, Ludmil , Raman spectra of various types of tourmaline. *European Journal of Mineralogy* **(1997),** 9(5), 935-940

RD5 Haskin L. A., Wang A., Rockow K. M., Jolliff B. L., Korotev R. L., Viskupic K. M. **(1997)** Raman spectroscopy for mineral identification and quantification for in situ planetary surface analysis: a point count method. *J. Geophys. Res. [Planets]*, **102(E8)**, 19293-19306