

Spectrometer ISEM for ExoMars-2020 space mission

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Abstract

Robust design, small dimensions and mass, the absence of moving parts in acousto-optic tunable filters (AOTFs) make them popular for space applications [1-3]. Here we introduce a pencil-beam near-infrared AOTF-based spectrometer ISEM for context assessment of the surface mineralogy in the vicinity of a planetary probe or a rover analyzing the reflected solar radiation in the near infrared range [4]. The ISEM (Infrared Spectrometer for ExoMars) instrument is to be deployed on the mast of ExoMars Rover planned for launch in 2020.

ISEM spectrometer

The instrument covers the spectral range of 1.15–3.3 μm with the spectral resolution of $\sim 25 \text{ cm}^{-1}$ and is intended to study mineralogical and petrographic composition of the uppermost layer of the regolith. The instrument targets waterbearing minerals, phyllosilicates, sulfates, carbonates in the vicinity of the Mars rover. Besides, it will help in real-time assessment of surface composition in selected areas, in support of identifying and selection of the most promising drilling sites. A study of variations of the atmospheric dust properties and of the atmospheric gaseous composition is also of interest.

The instrument consists of two parts: Optical Box (Fig. 1) and Electronic Box. The optical scheme includes entry optics, the AOTF, focusing optics, and a Peltier-cooled InAs detector. A wide-angle acousto-optic tunable filter manufactured on the base of TeO_2 crystal is used. Incident optical radiation has ordinary polarization and the diffracted optical beam has the extraordinary polarization. The angle between the passed and diffracted optical beams is 6° at the output of the AO crystal. A pair of polarizers with crossed polarizing planes is used to filter out the non-desired zero diffraction order.

Up to now, two qualification models have been manufactured. The test campaign is planned.



Fig.1. Optical Box of ISEM.

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