VISTA INSTRUMENT FOR ORGANICS AND VOLATILES CHARACTERIZATION OF ASTEROIDS REGOLITH AND COMETARY DUST BY USING TGA TECHNIQUE. E. Palomba[1], F. Dirri[1], A. Longobardo[1], D. Biondi[1], A. Boccaccini[1], A. Galiano[1], E. Zampetti[2], B. Saggin[3], D. Scaccabarozzi[3]; [1]IAPS-INAF, Via del Fosso del Cavaliere, 00133, Rome, Italy; [2]IIA-CNR, via Salaria km 29.300 Monterotondo, Rome, Italy; [3]Politecnico di Milano, Polo Territoriale di Lecco, Lecco, Italy; (ernesto.palomba@inaf.it).

Introduction: VISTA (Volatile In-Situ Thermogravimetry Analyser) is a Quartz Crystal Microbalance-based device developed by Italian consortium and leaded by IAPS-INAF. The instrument core is a Piezoelectric Crystal Microbalance (PCM), equipped with built-in heater and built-in temperature sensor. The Proximity Electronics (PE) is included in the sensor heads. The instrument is able to use the ThermoGravimetric Analysis (TGA) for dust and regolith characterization, i.e. a technique used to monitor thermal processes involving volatile compounds, e.g. deposition/sublimation and absorption/ desorption [1]. The PCM oscillation frequency linearly depends on the mass deposited on its sensible area, according to Sauerbrey equation [2], while the PCM temperature can be increased by using integrated heaters. VISTA was studied and selected for the Phase A for different Cosmic Vision Space Missions, such as the L2 JUICE [3], the M2 Marco Polo, the M3 Marco Polo-R [4] (where VISTA was selected for the scientific payload) and Mars [5]. An Engineering Model of VISTA has been developed during ITT ESA Project: i.e. CAM (Contamination Assessment Microbalance) (Fig.1). The VISTA scientific objectives are: 1) measurement of abundance of volatiles (e.g. water, organics) in planetary/asteroidal regolith and cometary-like activity; 2) measurement of dust and ice settling rate, water content in dust and humidity; 3) discrimination between water ice and clathrate hydrates on icy satellite surfaces; 4) monitoring the molecular contamination [6].

Fig.1. *VISTA1 Engineering Model developed for CAM-ESA ITT Project.*

Instrument concept and technical characteristic: VISTA is composed of two different sensor heads, i.e. VISTA1 (Quartz Crystal Microbalance-based device) able to monitor the molecular contamination in space [6] and VISTA2 ($GaPO_4$ Crystal Microbalance-based device) able to reach higher temperature (~550K) than VISTA1 to perform dehydration and organics decomposition in minerals [7].

VISTA1 is currently at TRL 6 whereas VISTA2 is at TRL 4/5. VISTA Main Electronic (ME) can be shared with other devices of the scientific package, reducing the instrument total weight. VISTA shows a very small mass (≤150g), low volume and power budget (≤1.62W) and needs a small amount of material for analysis, i.e. <1 mg.

Laboratory tests: VISTA laboratory breadboard has been validated at 193K and 10^{-7} mbar to simulate sublimation processes of pure organics compounds (dicarboxylic acids) from 298K to 353K. By measuring two different deposition rates, k_1 and k_2, at two different sample temperatures T_1 and T_2, it has been possible to obtain the ΔH_{sub} by means of Van't Hoff relation [8]. Thus different deposition curves (Fig.2) have been obtained.

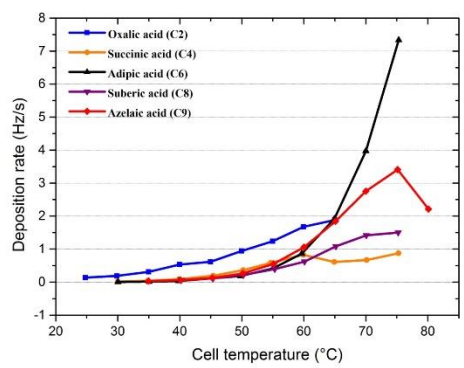

Fig. 5. *Dicarboxylic acids deposition curves [9].*

The results are in good agreement with literature [9]. The low mass and volume as well as the low power consumption and materials for analysis, makes VISTA a useful device for different space and planetary applications use (Mars, Venus, small bodies, molecular contamination monitoring onboard spacecraft/cubesat).

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