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Electrical Properties of Itokawa grains returned by Hayabusa

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1. Introduction

A wealth of data exists on the properties of lunar regolith samples returned by Apollo missions e.g. [1,2] as well as on terrestrial minerals. However such experimental data have not yet been collected on asteroids material. In this study we present the first measurements of secondary electron emission characteristics from areas of samples RA-QD02-0126-02 and RA-QD02-0136-14 returned by the Hayabusa mission under electronic irradiation in the range 200eV to 5keV. At sub-grain scale, secondary emission yields are found to be strongly dependent on surface composition, roughness and orientation of the illuminated surface of Itokawa particles. We compare them to reference measurements including grains and powders of materials such as terrestrial Forsterite and JSC-1 planetary analog. In addition we observe the build-up of local electric field patterns arising from surface electrostatic charging in relation with grains morphology. Consequences on our understanding of regolith properties and electrostatic effects on planetary regolith are addressed through a dedicated numerical modelling exercise fed by the results of the present work.

2. Some measurements results

The total secondary emission yield of Itokawa single particle RA-QD02-0126-02 (Figure 2) is found to be well in the range of Apollo 17 dust grains determined from low energy measurements, while observed to peak between 200 and 700 eV. The JSC-1 comparatively shows a slightly different trend with a lower energy peak closer to 250eV. Over very small areas of irradiation (<100nm) of JSC-1 sample, the trend changes drastically towards a reduced yield for energies larger than 1500eV, while it does not for Itokawa material. The yield of JSC-1 regolith is significantly reduced at low energies, as observed in previous studies on lunar analogs, due to escape velocities filtering and electrons trapping by neighbouring walls within the highly inhomogeneous material.

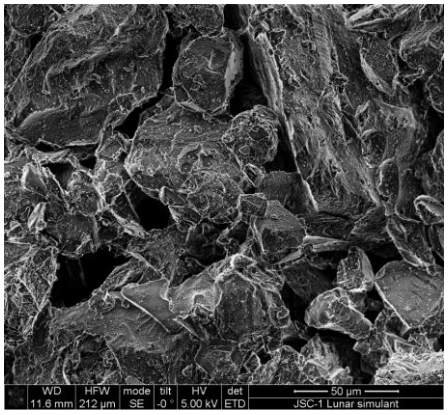

Figure 1: mapping of a JCS-1 analog layer in FE-SEM

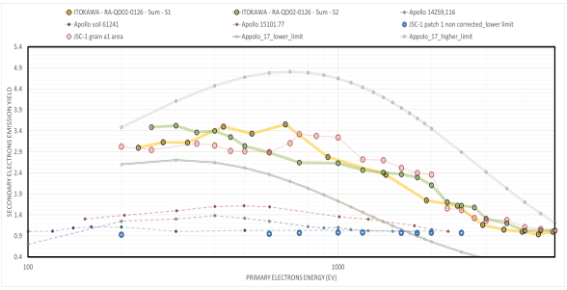

Figure 2: comparative secondary emission yields from Hayabusa sample RB-QD02-0126-02 areas and Appollo 17 samples.

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