Electrostatic Cleaner of Lunar Dust on Solar Panel and Optical Lens

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Outline

We are developing a self-cleaning device of lunar dust on a solar panel and optical lens utilizing electrostatic force.

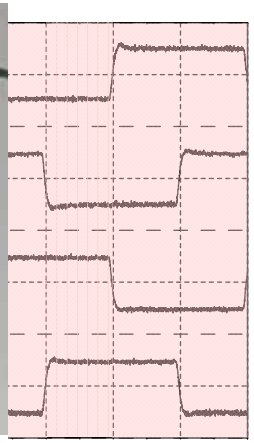
originally developed for toner transport in laser printer

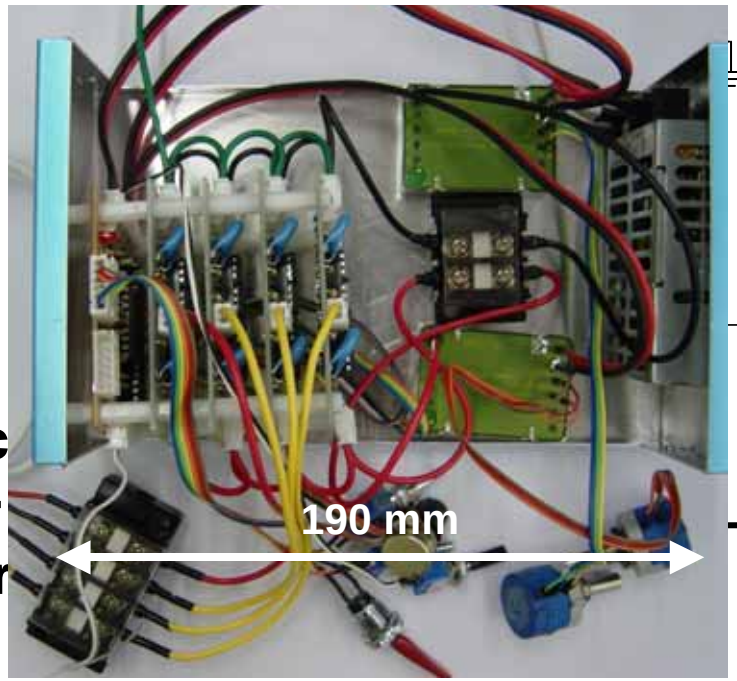
applied for lunar exploration

- **low power consumption with compact power supply**
- **high cleaning performance with transparent ITO electrodes**
- **effect of initial charge**
- **demonstration in lunar environment (vacuum and low gravity)**

Electrostatic Dust Cleaner System

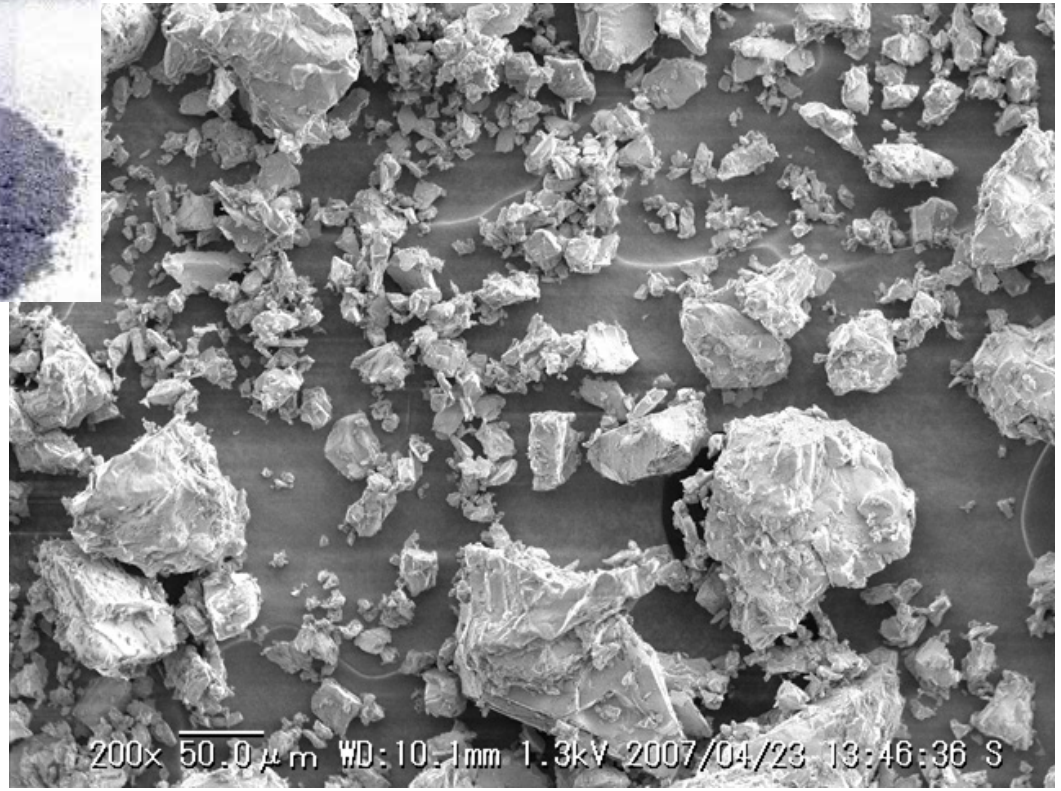
traveling wave transport of particles





Switc
power
contr

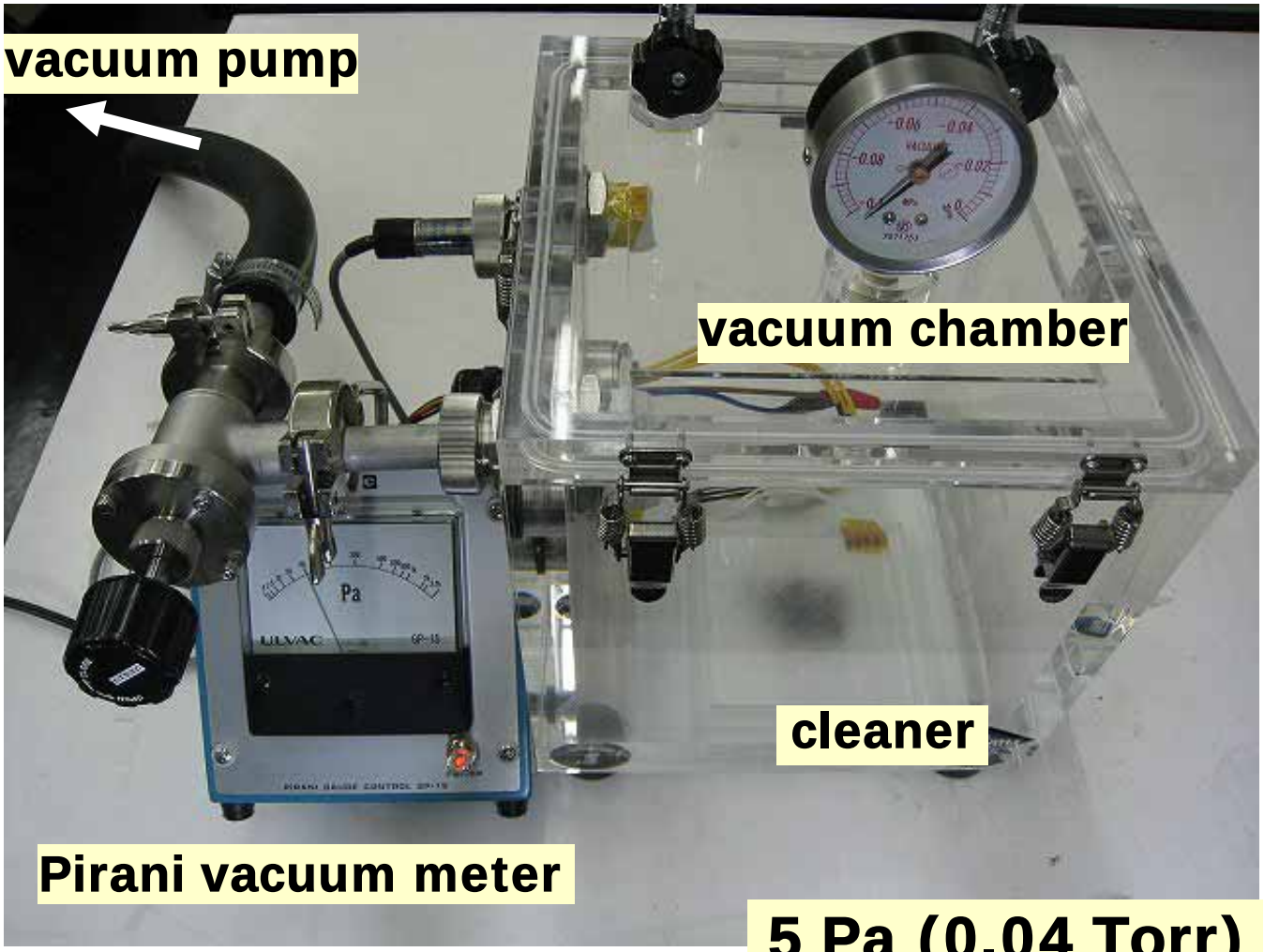
Photograph of Lunar Dust Simulant



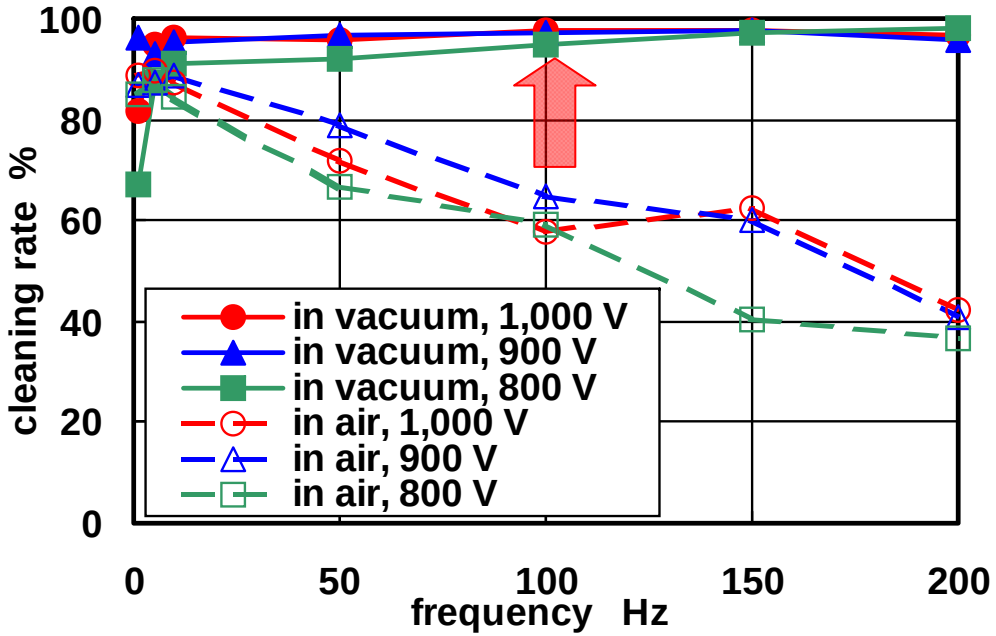
200X

Provided by Shimiz Corp.

Experiment in Vacuum Chamber



Cleaning Rate



in air (100 Hz)

in vacuum (100 Hz)

Numerical Simulation
-calculated by Discrete Element Method-

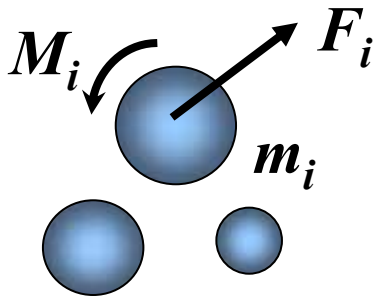
$$m_i\ddot{\boldsymbol{x}}_i + 6\pi\eta R\dot{\boldsymbol{x}}_i = \boldsymbol{F}_{coulomb_i} + \boldsymbol{F}_{dipole_i} + \boldsymbol{F}_{mechanical_i} + \boldsymbol{F}_{adhesion} + m_i\boldsymbol{g}$$

(Air Drag) **(Coulomb)** **(polarization)** **(collision)** **(adhesion)** **(gravity)**

↓

0, in vacuum

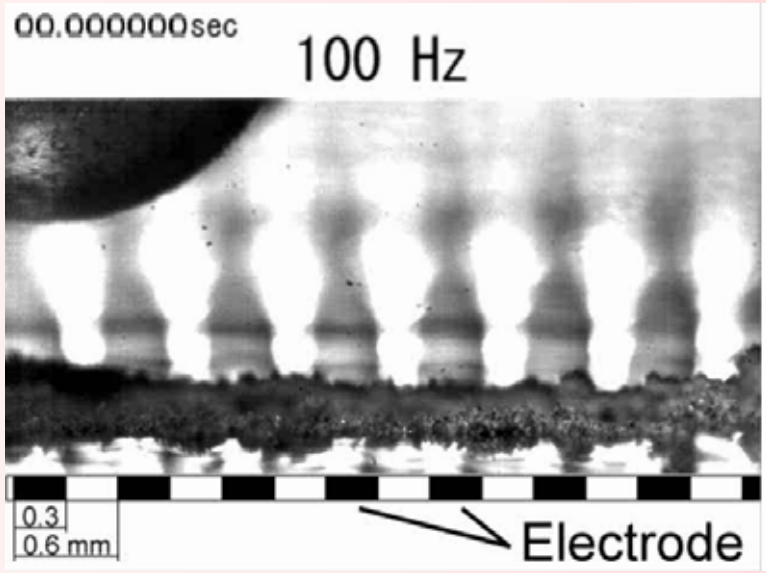
$$I_i\ddot{\boldsymbol{\theta}}_i = \boldsymbol{M}_{mechanical_i} + M_{friction_i}$$

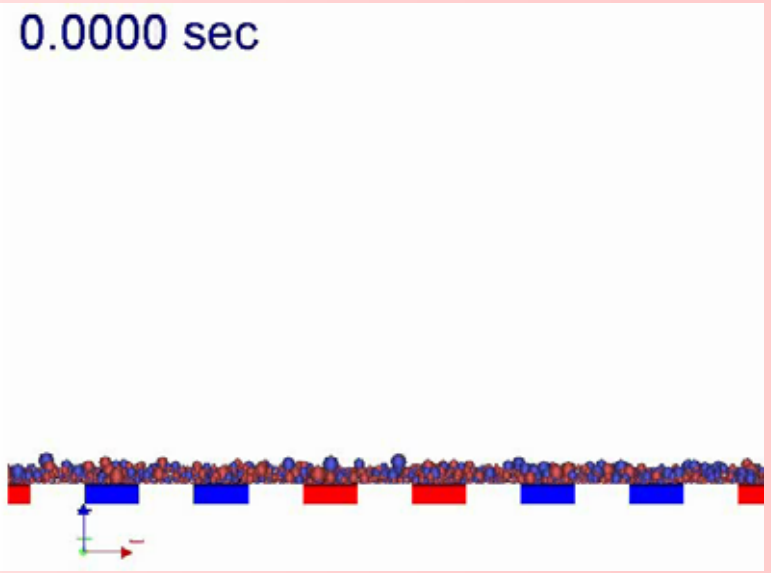


$(i = 1, \cdots, N \quad N : \text{number of particles})$

Transport of Particles in Air and Vacuum

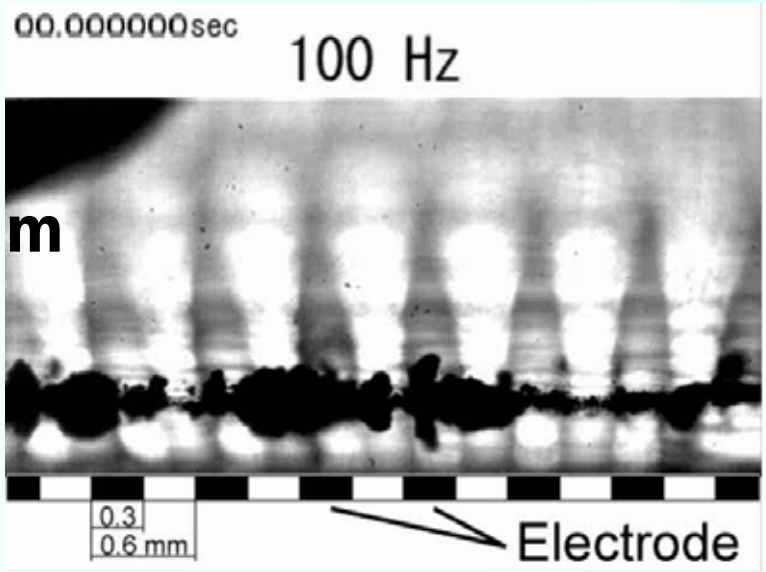
air

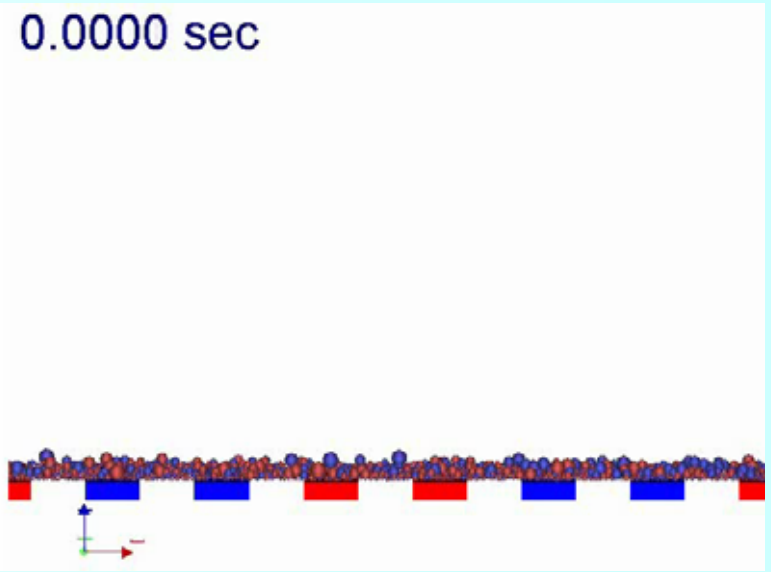




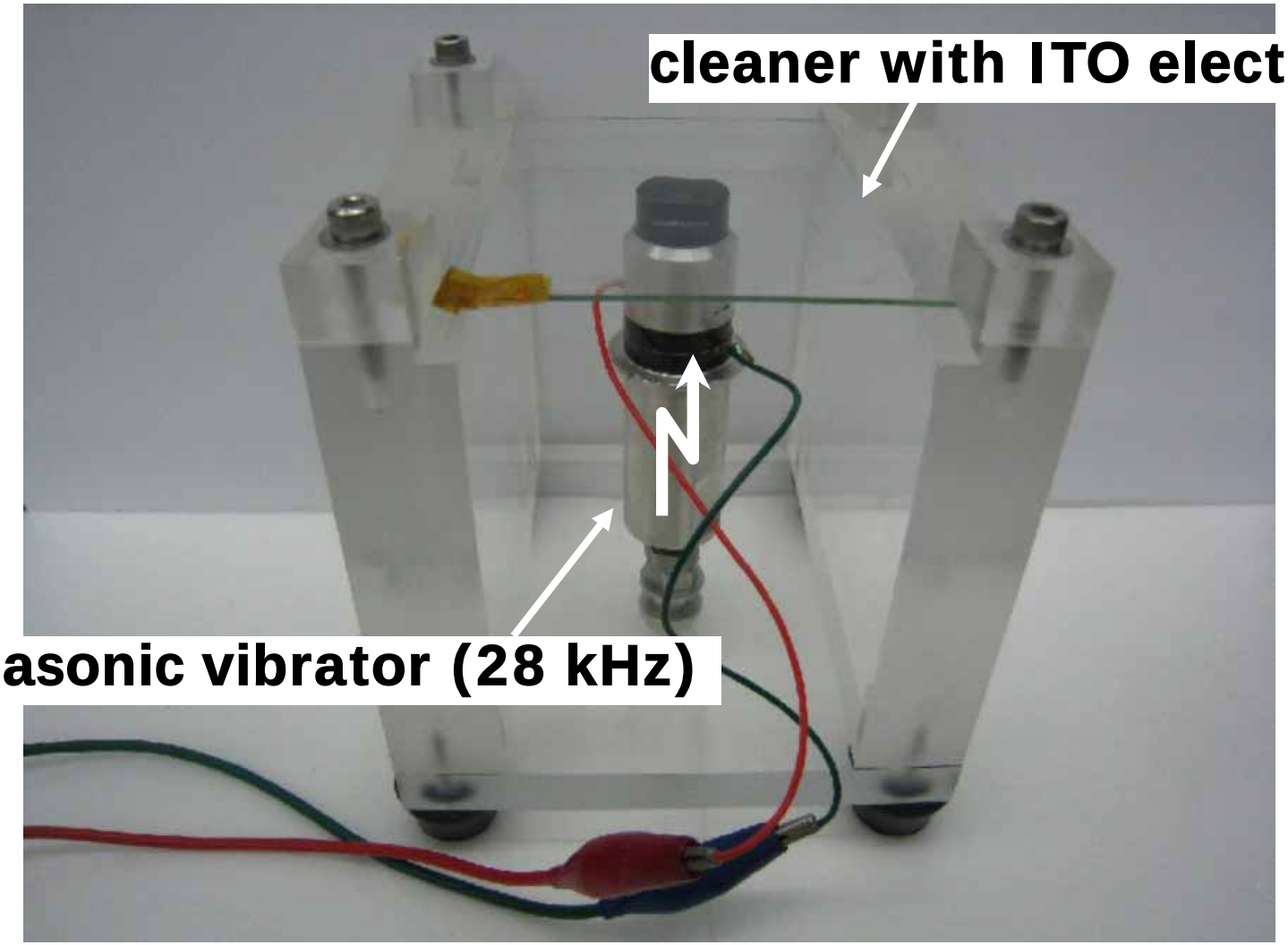
vacuum

10 Pa

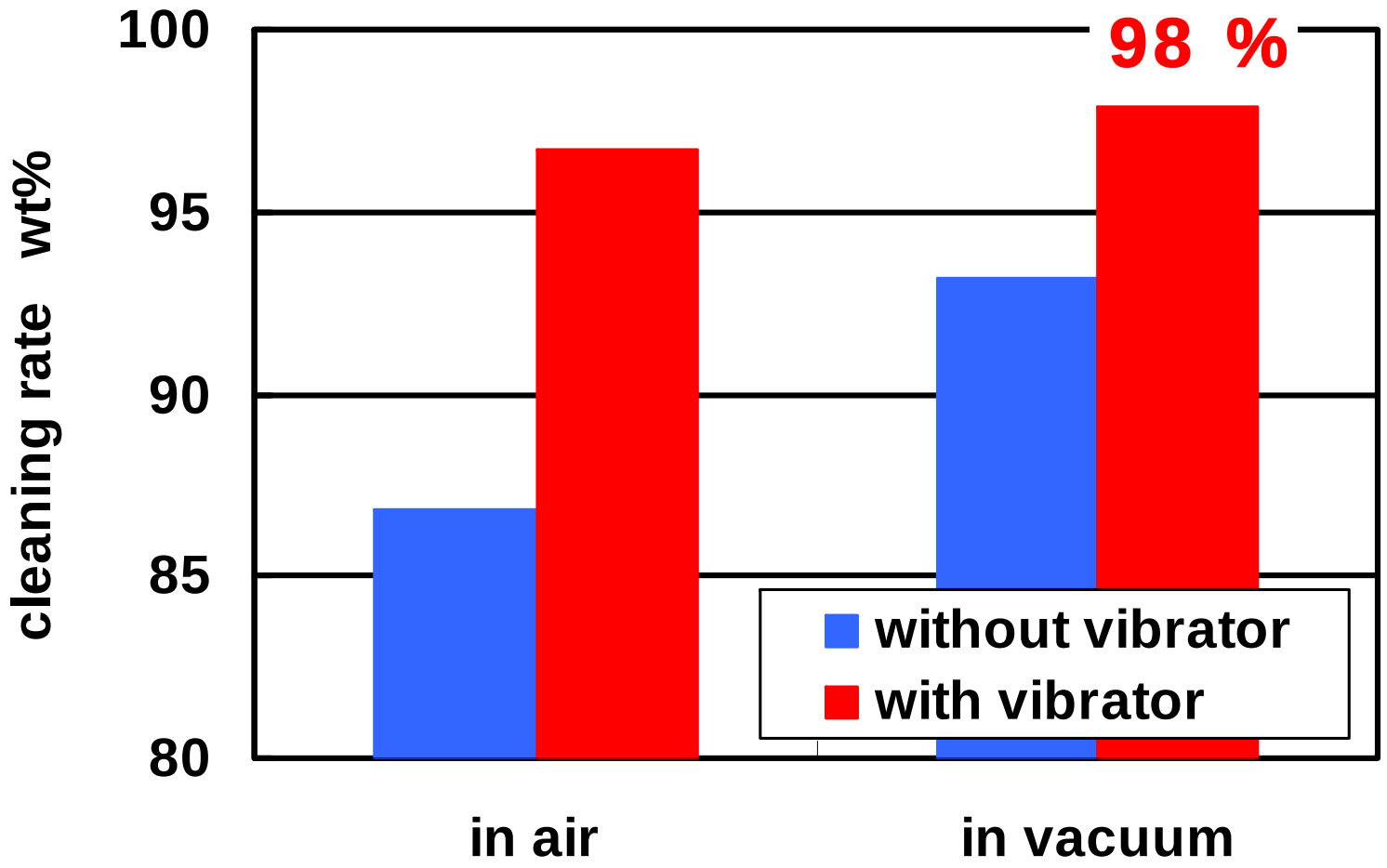




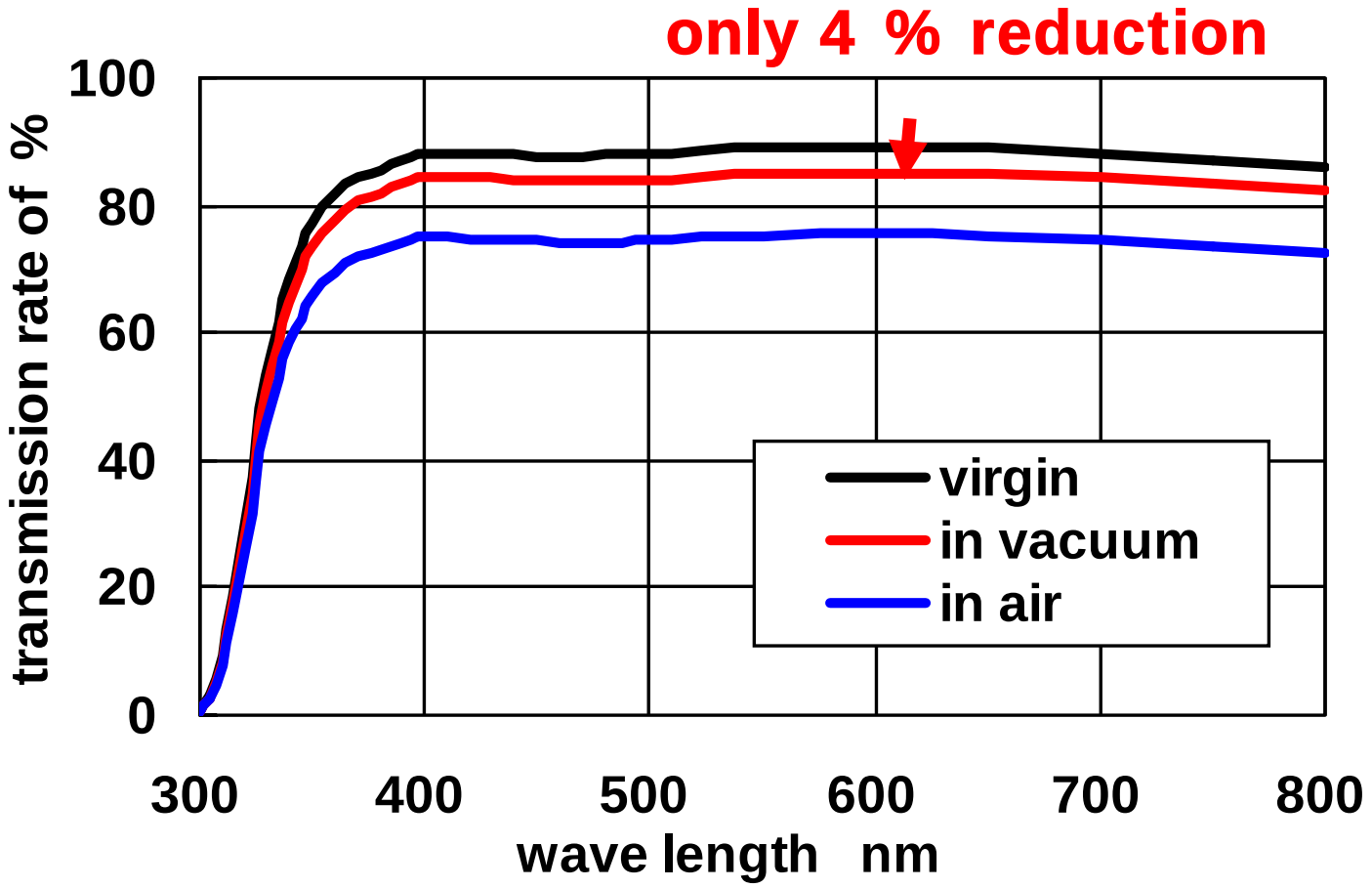
Cleaning Assisted by Ultrasonic Vibrator



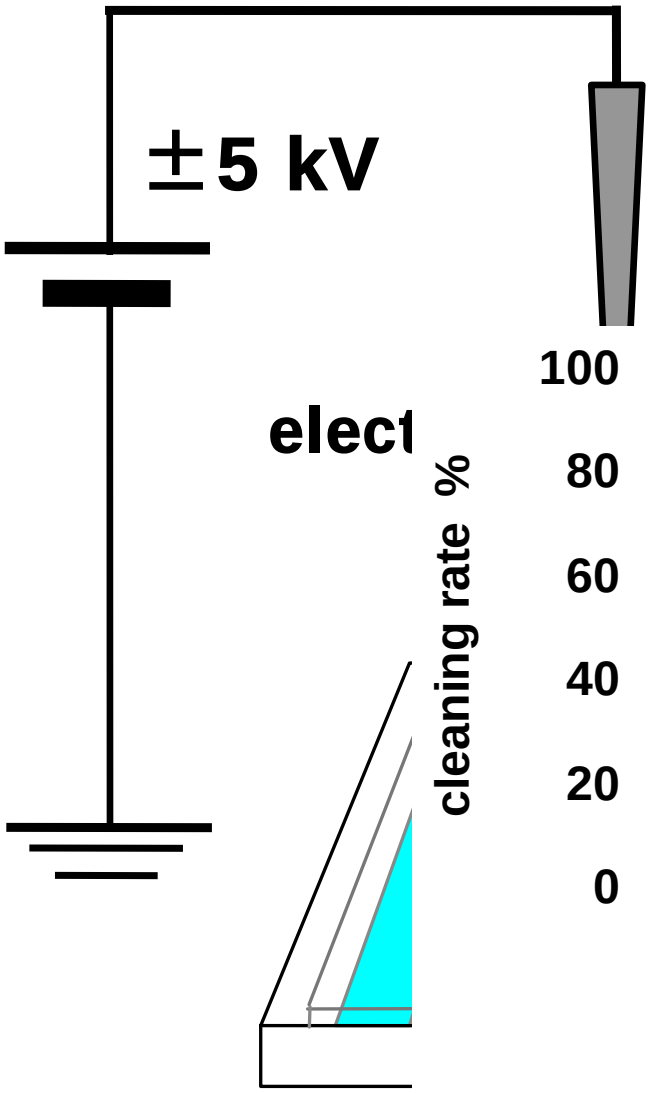
Improved Cleaning Performance with Ultrasonic Vibrator



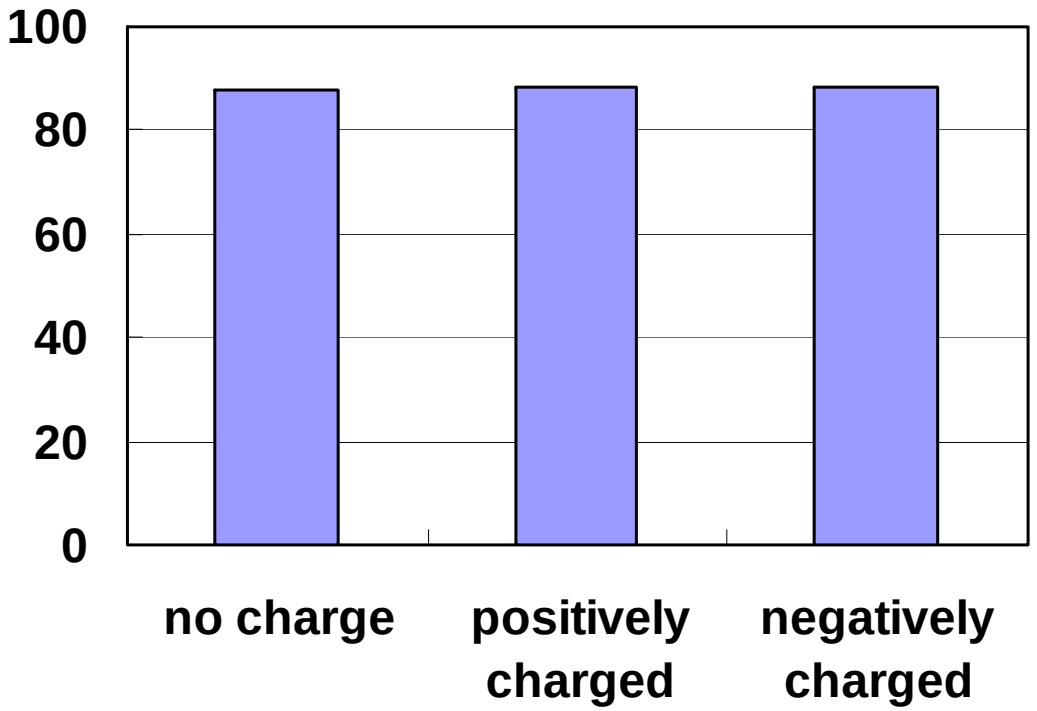
Transmission Rate of Light before / after Operation



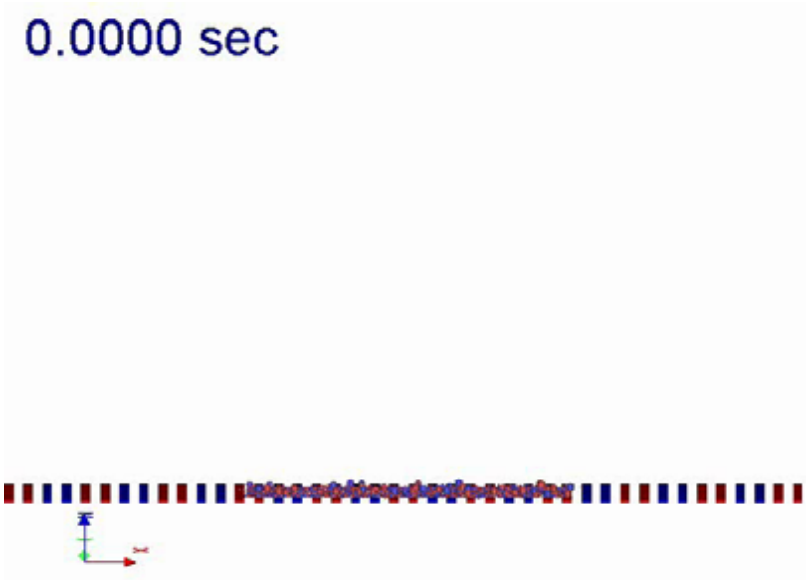
Cleaning Performance of Initially Charged Dust



Initially charged dust can be cleaned successfully.



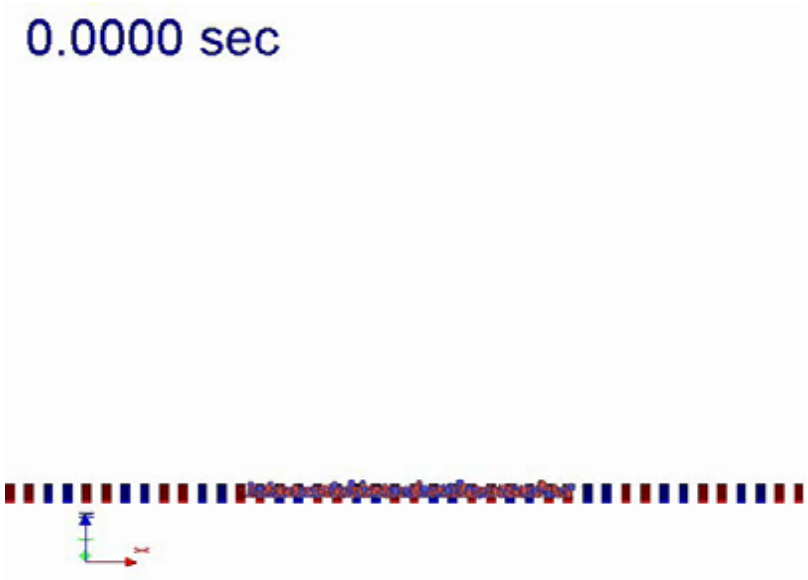
Cleaning Performance on the Moon



on the earth

700 V 10 Hz

- **1 G**
- **in air**



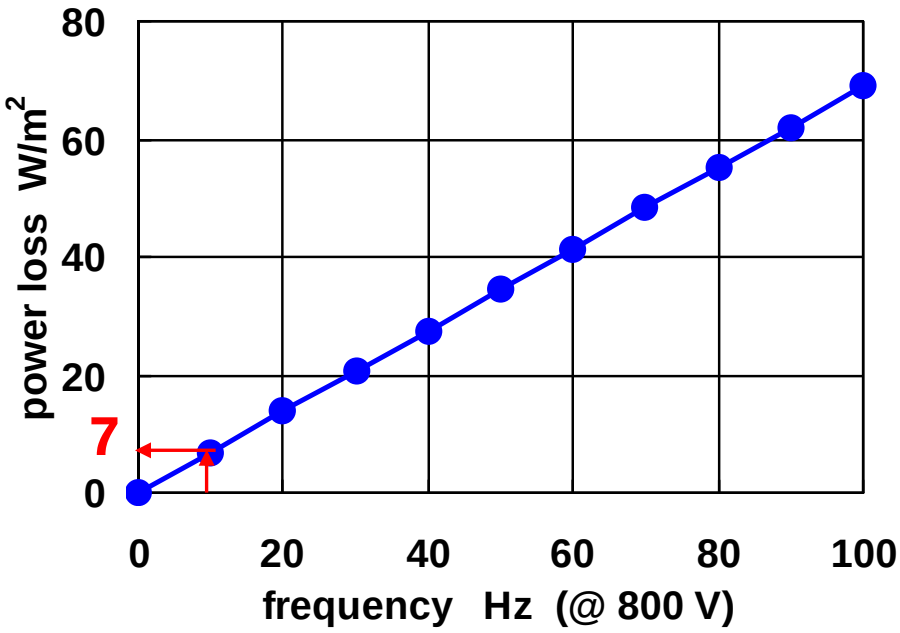
on the moon

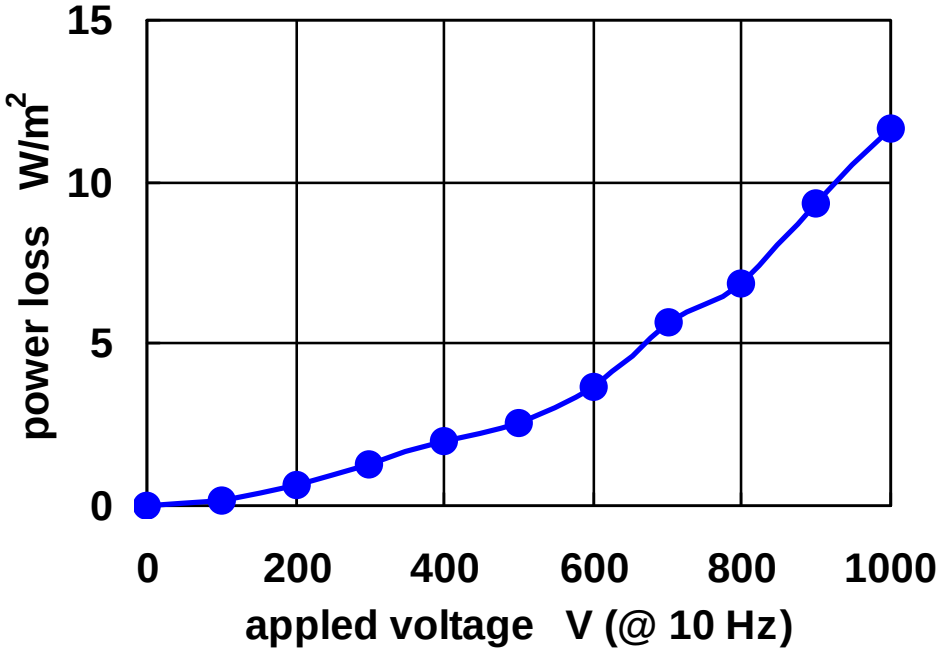
700 V 10 Hz

- **1/6 G**
- **in vacuum**

Power Consumption

@ 1 m² cleaner





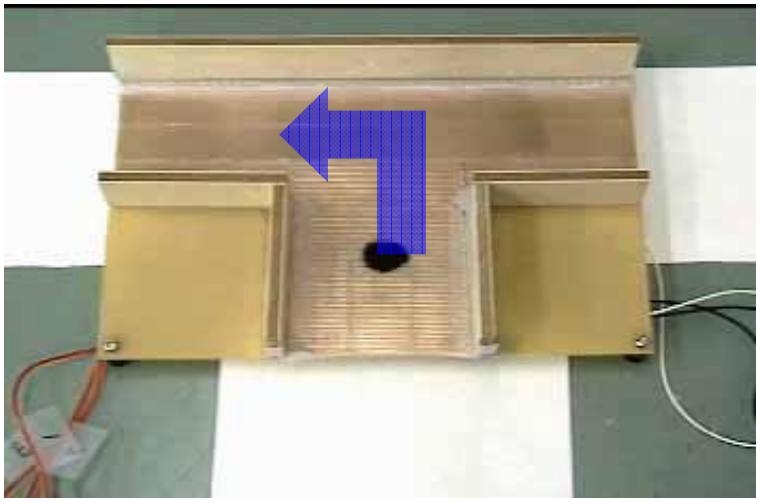
estimated power consumption:
7 W ×30 sec. = 0.06 Wh for 1 m² cleaner

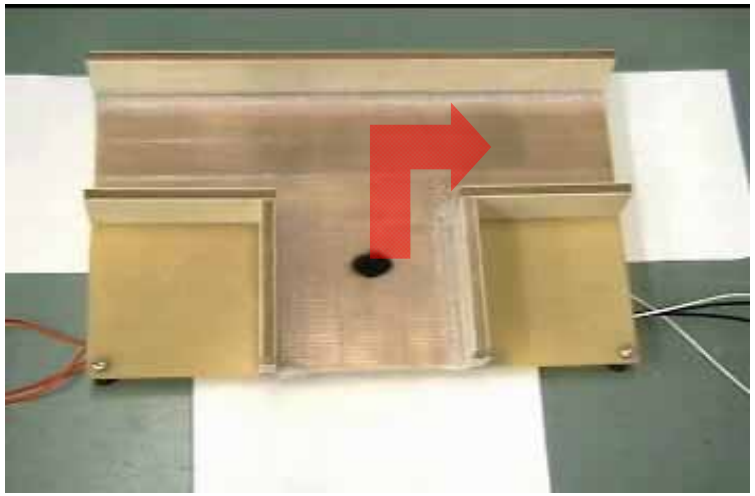
Concluding Remarks

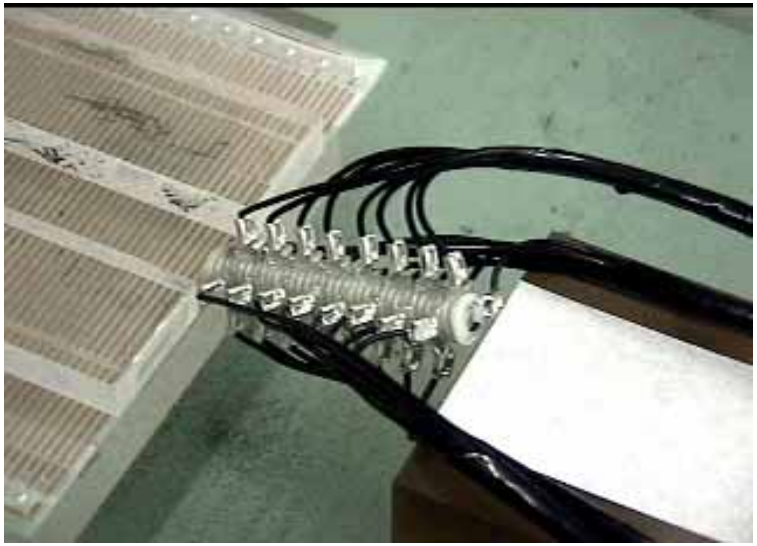
Numerical and experimental investigations were carried out on the electrostatic transport of particles to apply for the cleaning of lunar soil and dust.

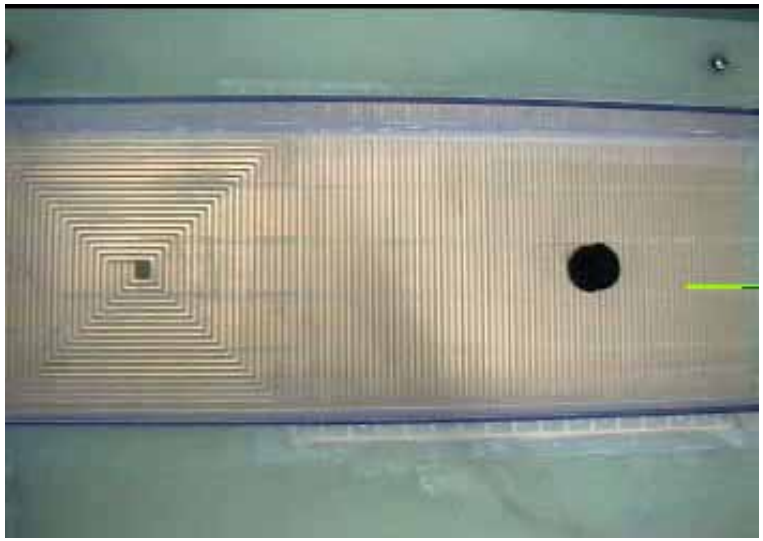
- ☑ compact & light power supply
- ☑ transparent IOT conveyer
- ☑ demonstration in vacuum
- ☑ high cleaning performance
- ☑ effect of initial charge
- ☑ high transparency
- ☑ performance prediction on the moon
- ☑ low power consumption

Application of Electrostatic Particle Transport for Lunar Resource Utilization









Thank you for your attention.

For more information

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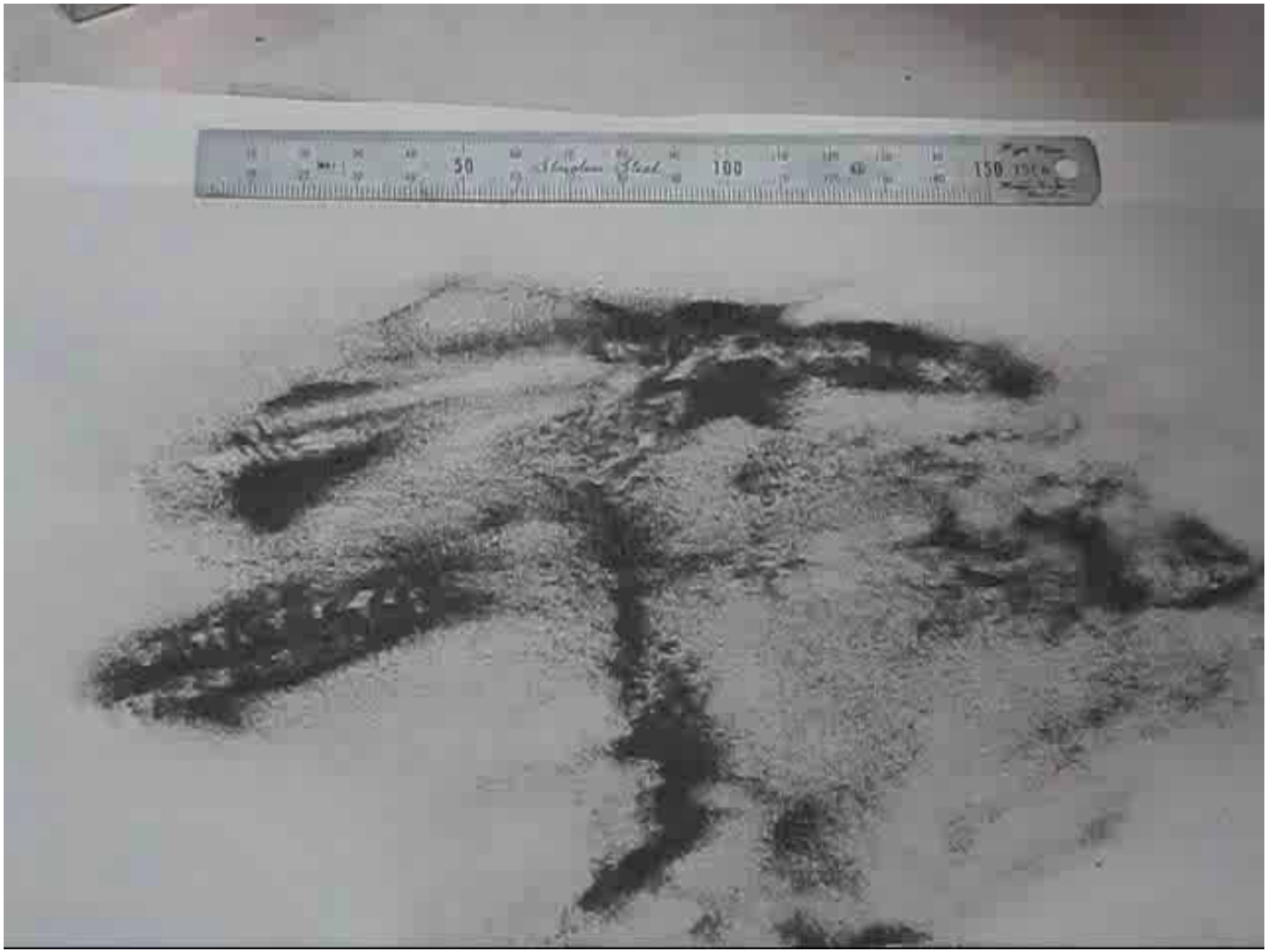
Electrostatic Cleaner of Lunar Dust Adhered to Spacesuits



We need your support !!

We need textile of spacesuits for the demonstration of our cleaner.

Please provide for us.

We will report the results of our investigation.