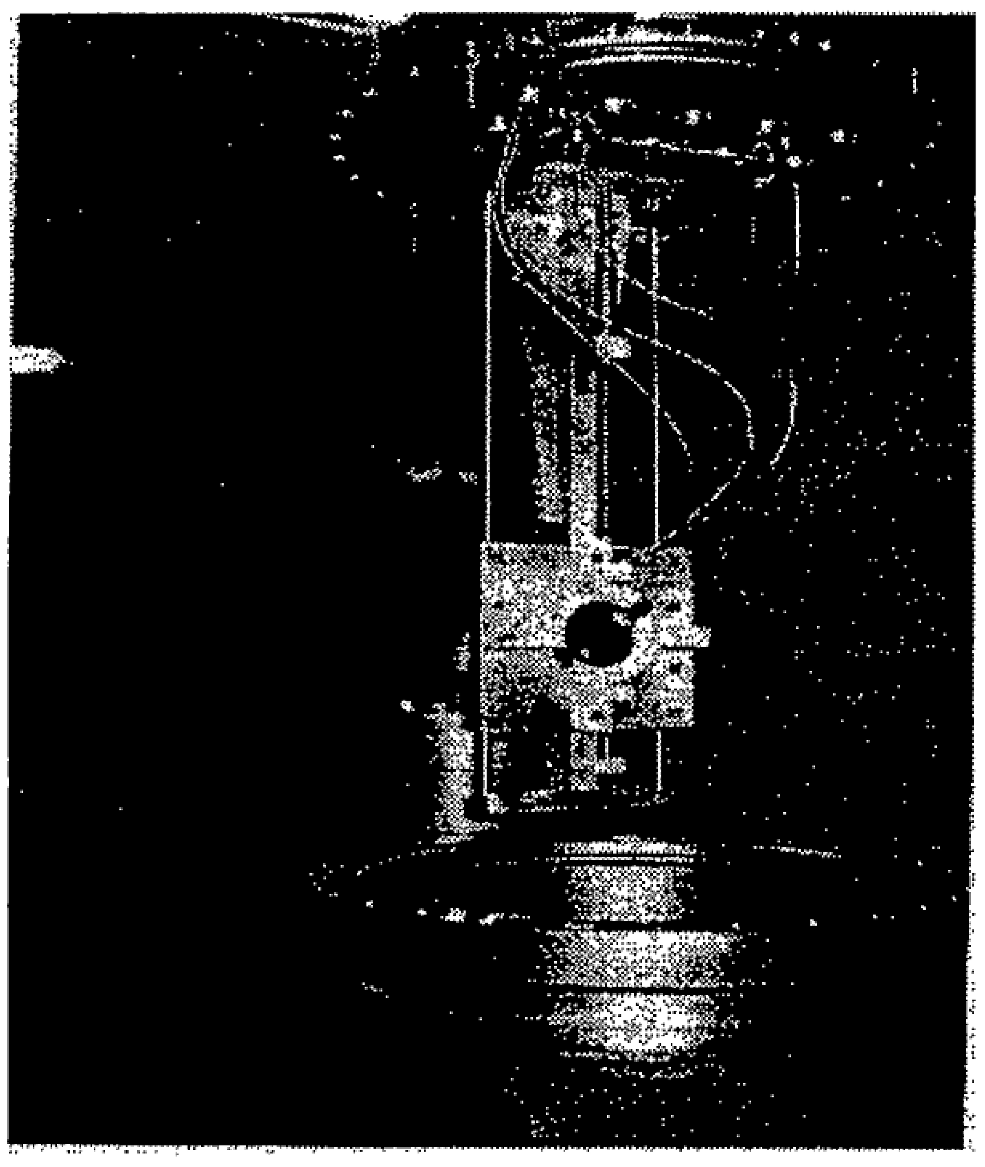

Figure 4 : Experimental set-up.

2.3.2. Tests.

The main purposes of the preliminary tests performed with the dust accelerator at Heidelberg were to monitor the behaviour of the electronics and to define the detection range of the two kinds of detectors available. In particular it was necessary to investigate the :

- Variation of the discharge amplitude with the energy of the particles.
- Detection threshold versus mass and velocity.
- Detection threshold versus dielectric thickness.
- Detection threshold versus bias voltage.

The behaviour of the electronic circuit has been satisfactory : for a discharge higher than the detection threshold (95% of bias value), the value of the discharge voltage is obtained and the counter is incremented. The shape of the signal is similar to the one obtained upon simulated discharge/7,8/, with a fast discharge rate of a few µs, consistent with previous tests/5/, see figure 5. Delay before recharge was changed from 500 µs to 20 µs, without influence on the detection performance (using for the tests a maximum impact rate of 5 impacts/s).

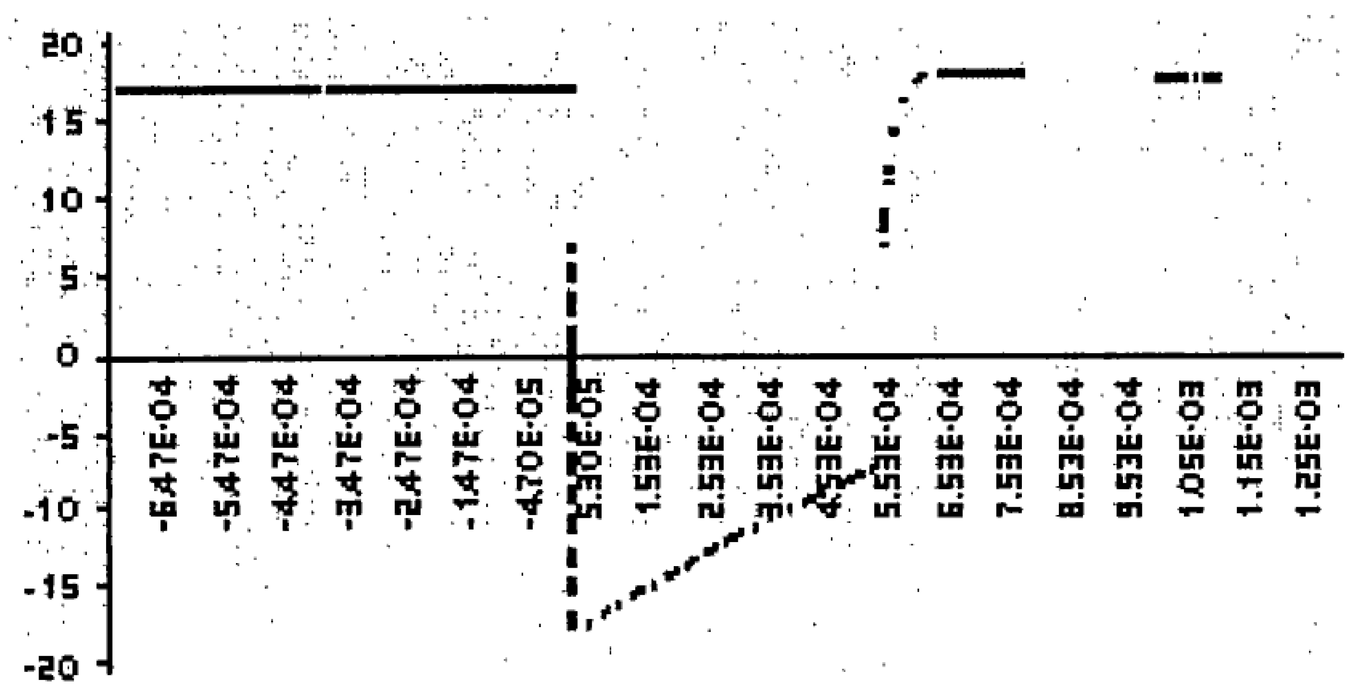

Figure 5 : Typical discharge signal

The value of the voltage after impact is usually half the value of the nominal bias voltage, thus indicating an almost complete discharge, the results are similar to the ones reported by Kassel /5/.

There is a fair positive correlation between the amplitude of the discharge and the kinetic energy of the particles.

Detection threshold is reached at a :

- Velocity of 2 km/s for a particle with a 1.3 µm diameter.
- Velocity of 8 km/s for a particle with a 0.6 µm diameter.

Dielectric thickness : it was not possible to find a significant difference in sensitivity between the sensors with a dielectric 1.4 µm or 1.0 µm thick.

Bias : The value of the bias voltage has a prominent influence on the behaviour of the sensors. A detection threshold for the 1.4 µm sensors has been found with a bias value of 40 volts and with a value of 35 volts for the 1.0 µm sensors. Optimum performance was obtained with a bias value close to 50 volts for both sensors.

Appraisals : confirmation of local mechanical behaviour. Only one failure for 4 detectors tested see figure 6.

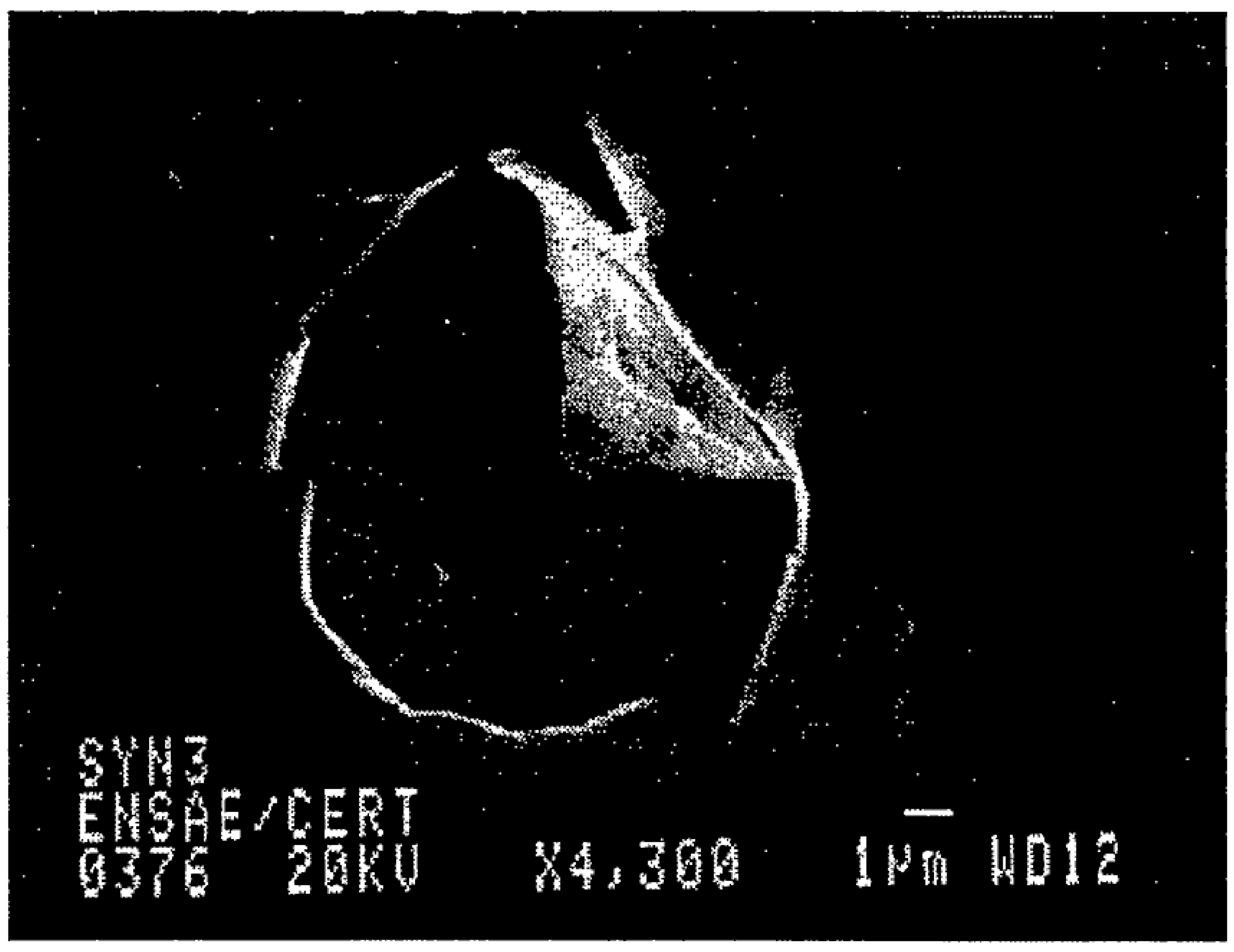

Figure 6 : Typical impact on MOS sensor

3. DISCUSSION

Behaviour of the sensors under hypervelocity impact tests was good, however further testing will be necessary in order to get a more precise calibration and a better understanding of the discharge process. The breakdown mechanism responsible for producing the signal is very complex, with several factors participating at various stages of the discharge event. First, the high pressure resulting from the impact, could cause an electromechanical breakdown of the dielectric, initiating the discharge; second, the material in the impact region could be highly ionised, hence acting like a metallic conductor and sustaining the discharge.

4. PLANNING

Following these ideas, detectors are currently developed for use on the MIR space station. Next flight is schedule in 1999. In this case , we could retrieve detectors and perform appraisals to compare results with ground simulations. We plane to use at least two sensors on opposite faces (ex. +V,-V) with two different dielectric thickness. Results will be stored during mission (about 1 year) and evaluated after flight. According we want to explore new orbits and to monitor event, we envisage :

a collaboration with Israel to take on board our detectors on it polar orbit satellite which will fly in 1999. It name is TECHSAT

* a use of this experiment on French satellite STENTOR with a geostationary orbit and a flight in 1999.

For these last missions we will have telemetry's to evaluate results during flight. We will use detectors as long as possible.

1997 qualification model and ground tests

1998 tests continuation and flight models making

1999 integration on satellites.

5. CONCLUSION

The type of detector described in this paper can be used to monitor the small particulate earth environment. It is best suited to the detection of micron sized particles on a routine basis. Its foreseen use on satellites in geostationary or polar orbits could increase our knowledge on the distribution and on the evolution of man-made orbital debris.

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