CNRS *Centre National de la Recherche Scientifique*
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OUTGASSING TEST OF AREMCO 571 VACUUM ADHESIVE

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CHANGE RECORD

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Approved by:		

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In this note we briefly report the outgassing measurements performed on the Aremco 571 adhesive for UHV. The measurement method is described in detail in VACPISA 025.

1 - System performances

We performed a baking of the test chamber at 250 ^{0}C for 12 days and we got:

t(h)	T(^{0}C)	p_1(mbar)	p_2(mbar)	Q(mbar l/s)
after	25	1.1×10^{-9}	1.7×10^{-10}	1.9×10^{-8}

The main components of outgassing after baking were H_2, H_2O, N_2/CO, CO_2. The internal surface of the chamber is 3200 cm^2.

2 - Measurement of the outgassing rate of Aremco 571

The experimental sample was the ceramic adhesive Ceramabond 571 manufactured by Aremco, USA and suggested us by GEO600. It is a completely inorganic (magnesia and alumina) adhesive for bonding and coating high expansion metals; the bonding agent is silicate based. The sample was prepared by mixing 1.5 parts of solid and 1 part of liquid, four hours staying at room temperature and several hours at 150 ^{0}C. The exposed surface was 259.2 cm^2.

We monitored the evolution of outgassing (time is measured from beginning of the test through the whole paper):

t(h)	T(^{0}C)	p_1(mbar)	p_2(mbar)	Q(mbar l/s)
0.5	25	3.3×10^{-5}	3.5×10^{-6}	5.9×10^{-4}
163	25	2.7×10^{-5}	1.4×10^{-6}	5.1×10^{-4}

The spectrum taken after 163 hours is shown in Fig. 1.

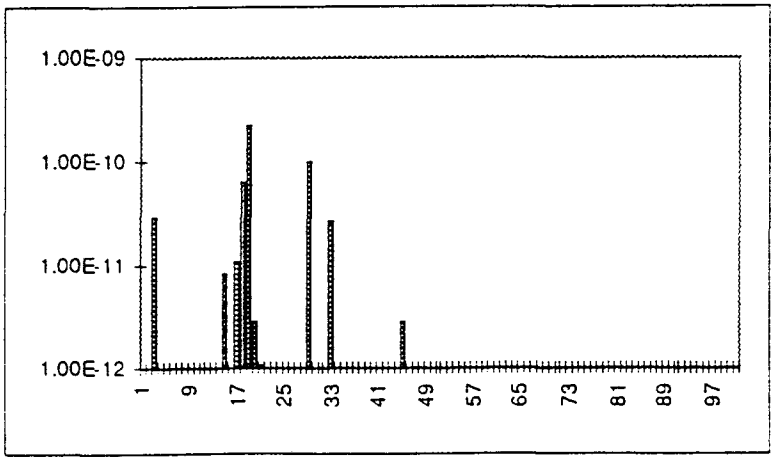

Fig. 1 Outgassing spectrum after 163 hours pumping at room temperature

There is a relevant contribution from water. We checked that the peak at 32 was not due to a leak.

We set temperature at 50 °C for 312 hours and monitored the evolution of outgassing:

t(h)	T(^{0}C)	p_1(mbar)	p_2(mbar)	Q(mbar l/s)
163.5	50	2.4×10^{-4}	7.5×10^{-6}	2.8×10^{-3}
165	50	1.1×10^{-4}	7.0×10^{-6}	2.1×10^{-3}
215.55	50	2.8×10^{-6}	8.9×10^{-7}	3.8×10^{-5}
311.75	50	3.2×10^{-7}	1.2×10^{-7}	3.0×10^{-6}
383	50	2.4×10^{-7}	1.3×10^{-7}	2.2×10^{-6}
385	50	2.4×10^{-7}	1.5×10^{-7}	1.8×10^{-6}
475	50	1.8×10^{-7}	1.2×10^{-7}	1.2×10^{-6}

A spectrum taken after 222 hours at 50 °C is shown in Fig. 2.

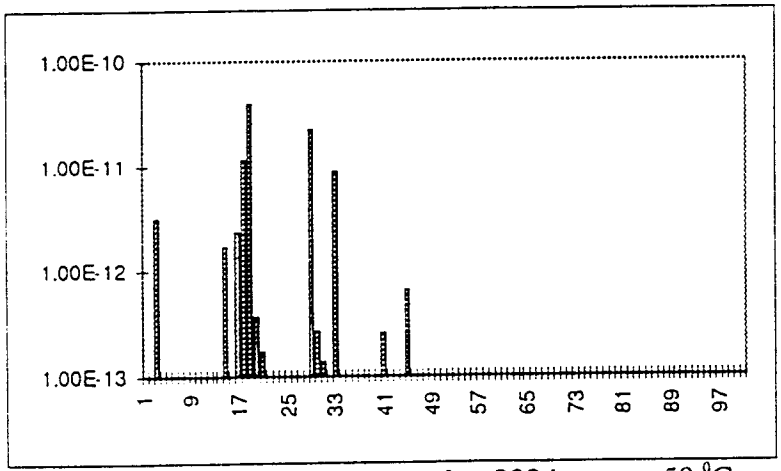

Fig. 2 Outgassing spectrum after 222 hours at 50 °C

We set temperature at 100 °C for 195 hours and monitored the evolution of outgassing:

t(h)	T(^{0}C)	p_1(mbar)	p_2(mbar)	Q(mbar l/s)
476	100	8.6×10^{-5}	7.6×10^{-6}	1.6×10^{-3}
477	100	8.0×10^{-5}	7.0×10^{-6}	1.5×10^{-3}
498	100	1.2×10^{-6}	3.8×10^{-5}	7.4×10^{-4}
530	100	6.2×10^{-7}	4.9×10^{-7}	2.6×10^{-6}
550	100	5.1×10^{-7}	3.9×10^{-7}	2.4×10^{-6}

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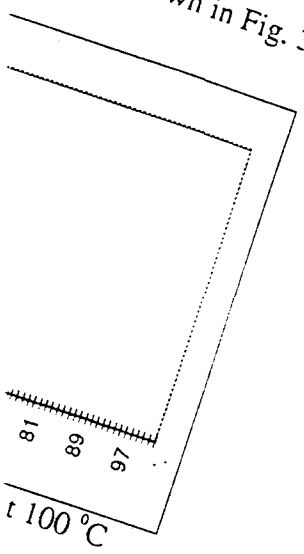
4.0x10-7

2.0x10-7

100 °C is shown in Fig. 3.



t 100 °C

olution of outgassing:

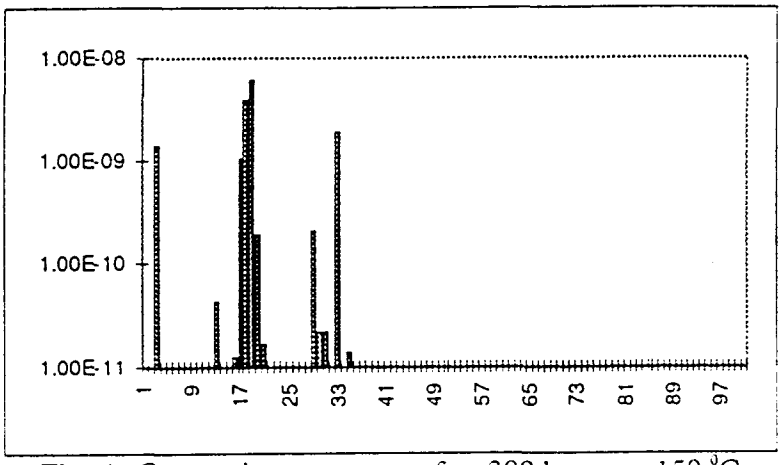


Fig. 4 Outgassing spectrum after 308 hours at 150 °C

We switched off the heating and we measured:

t(h)	T(°C)	p_1(mbar)	p_2(mbar)	Q(mbar l/s)
979.25	130	1.5×10^{-6}	3.6×10^{-8}	2.9×10^{-5}
980	120	6.9×10^{-7}	1.6×10^{-8}	1.3×10^{-5}
980.25	100	2.6×10^{-7}	7.6×10^{-9}	5.0×10^{-6}
980.5	88	1.2×10^{-7}	4.3×10^{-9}	2.3×10^{-6}
980.75	80	7.2×10^{-8}	3.1×10^{-9}	1.4×10^{-6}
981.5	70	2.6×10^{-8}	1.8×10^{-9}	4.8×10^{-7}
982.25	60	3.0×10^{-10}	2.3×10^{-10}	1.4×10^{-9}
1050.75	23	2.6×10^{-10}	2.1×10^{-10}	1.0×10^{-9}
1056	25	2.7×10^{-10}	2.2×10^{-10}	1.0×10^{-9}
1121	25	2.1×10^{-10}	1.7×10^{-10}	8.0×10^{-10}
1192	25	1.8×10^{-10}	1.4×10^{-10}	8.0×10^{-10}
1221	25	2.4×10^{-10}	2.0×10^{-10}	8.0×10^{-10}

The spectrum measured after cooling down is shown in Fig. 5.

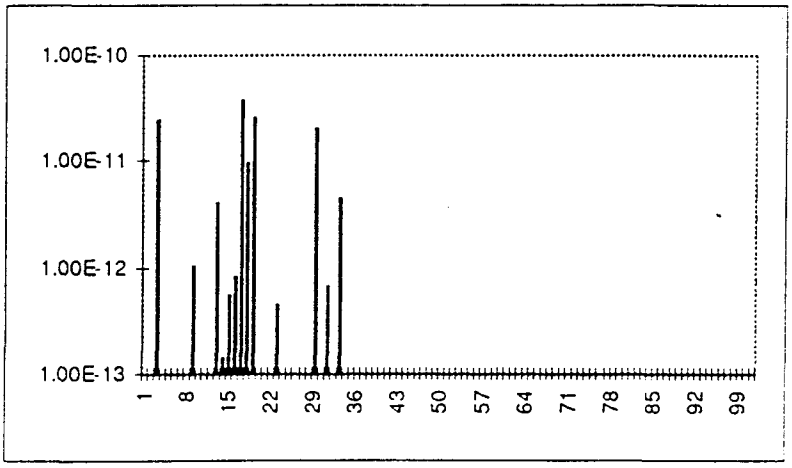


Fig. 5 Outgassing spectrum after thermal cycle

We did not observe any organic contamination even at the highest temperature.

The outgassing rate evolution is summarized in Fig. 6.

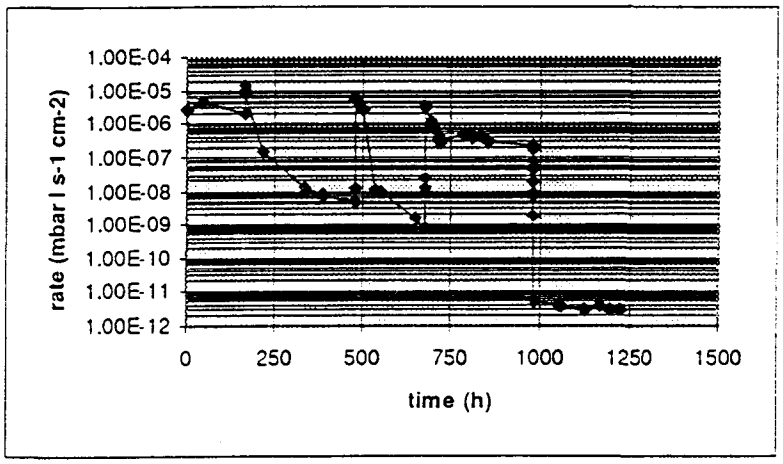


Fig. 6 Time evolution of the outgassing rate

3 - Discussion

The outgassing rate attained by the Ceramabond 571 adhesive after the thermal cycle was 3.1×10^{-12} mbar l s^{-1} cm^{-2}. We did not observe any organic contamination even at 150 °C, the main contribution being water vapor, which is removed by the vacuum baking. The observed oxygen peak at mass 32 can be explained by the porosity of the material. The adhesive can be recommended even for use in the cleanest vacuum. Some further investigations are required:

- mechanical strength of the bonding

- aging of the bonding
- effect of the adhesive on quartz surface and on the mirror Q

Contact are in progress with GEO600, where they are investigating the possibility to use 571 and similar ceramic adhesives and sealants for:

- preparing inorganic coatings for wire insulation (on the style of the alumina insulation wires whose test is described in the note VACPISA 037)
- bonding and dust sealing of magnets
- encapsulation of control components such as coils and photodiodes