

Verification for advanced satellite missions by evaluating space environment resistance of adhesive material

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1. Research background

In recent years, the use of adhesive materials in space environment has been drawing much attention. For example, sampling is performed using an adhesive material in the next asteroid explorer, and an adhesive material is used as a method for collecting debris.

2. Purpose of research

In this research, we evaluated the durability of various silicone adhesive materials and acrylic adhesive materials to various space environments, assuming that adhesive materials will be used in the future next-generation space development and exploration.

3. Result

3.1. Tack test under vacuum environment

Although the usual tack test is carried out in the atmosphere, the tack value under the vacuum environment is important in the universe. Therefore, the tack value of the adhesive material in the atmosphere and vacuum was compared. Tack value hardly changed in the atmosphere and in vacuum.

Table 1 Tack test under vacuum environment

Degree of vacuum [Pa]	Tackiness [N]
Atmosphere	2.6
4.0×10^{-2}	2.7
4.0×10^{-3}	2.6

3.2. Space environment simulation test

Vacuum exposure test was conducted. The test results are shown in Fig. 1. The results of the durability of the adhesive material by the UV irradiation test are shown in Fig. 2.

Irradiation for about 5 days on orbit was performed using atomic oxygen irradiation equipment. Fig.3 shows the results.

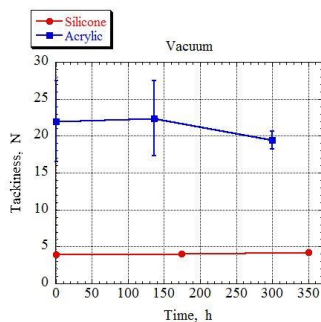


Fig.1 Vacuum exposure test results

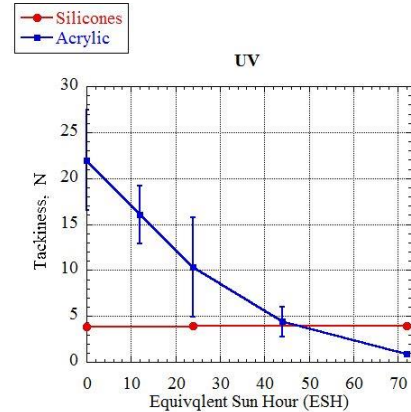


Fig.2 Ultraviolet irradiation test result

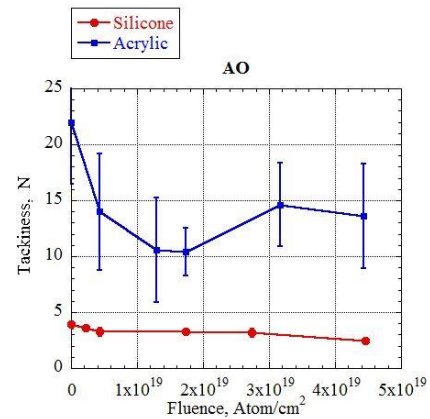


Fig.3 Atomic oxygen irradiation test result

4. Conclusion

In this study, we could investigate the change of the properties of silicone adhesive and acrylic adhesive for various space environments. It was confirmed that the acrylic adhesive is susceptible to ultraviolet rays but resistant to atomic oxygen to some extent. An oxide film was formed on the surface due to the influence of atomic oxygen, and it was found that although the tack value gently decreased, the resistance to ultraviolet light was strong in the silicone type adhesive material. We think that it is possible to use silicone adhesive if temperature control of adhesive material is done in deep space where there is no atomic oxygen but in this case it is necessary to know the influence of radiation. This requires further investigation.