NEWS RELEASE

NGK SPARK PLUG CO., LTD.
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URBANNET NAGOYA NEXTA Bldg.
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January 24, 2023

NGK SPARK PLUG CO., LTD.

NGK Spark Plug's Solid State Battery Passed Verification Test on HAKUTO-R Lunar Lander

～Adaptability proven in harsh environments / Possibilities expanding for reliable and safe battery supply in future society～

NGK Spark Plug Co., Ltd. (President: Takeshi Kawai, Headquarters: Higashi-ku, Nagoya), a Corporate Partner of the commercial lunar exploration program HAKUTO-R, proudly announces that its solid-state batteries installed on the HAKUTO-R Lunar Lander successfully completed their first planned operational verification in space.
Our solid-state batteries were confirmed working normally in outer space as a result of the test.

■Details of the verification test

In Mission 1 of the HAKUTO-R program, two of our solid-state batteries are installed on the Series 1 lander. One is installed in the payload area inside the lander (same environment as the lander's main components) and the other is installed on the top panel of the lander where it can be tested while directly exposed to the environment of space. This makes it possible to demonstrate the technology in different environments.

*Installation image (using a lander model



Location 1: Inside the lander



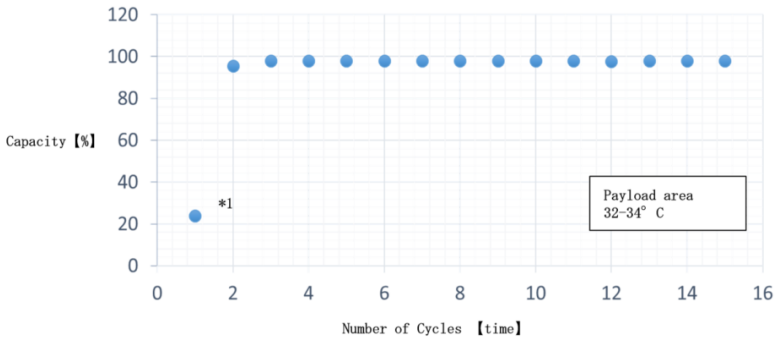
Location 2: On the top panel

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These batteries will be exposed to harsh conditions such as radiation in space and on the Moon, severe vibrations and shocks during launch and lunar landing, vacuum, and temperature changes from as low as -30°C to as high as 100°C (sunshine and shadow, environment dependent).

check	Milestone	success criteria
Completed	Ready to launch	・Clear space environment test (ground) ・Safety test (ground) cleared
Completed	Initial charge/discharge in space	・Clear the vibration and impact of rocket launch ・Initial operation check in high vacuum
Completed	Stable operation in space for one month	・Completed charge/discharge cycle evaluation for about one month ・Confirmation of operation in outer space more than 1 million kilometers away from the earth
	Charge/discharge evaluation in lunar orbit	・Completed charge/discharge cycle evaluation for about 4 months ・Operation check for about 4 months in a radiation environment
	Initial charge/discharge on the moon	・Clears vibration and shock during moon landing
	Operation demonstration on the moon	・Completion of charge/discharge evaluation in high temperature environment



Cycle evaluation results in outer space

*1: Since the battery capacity at launch was set to 30% or less, the capacity in the first cycle is low.

We plan to test the operation of two solid-state batteries both in outer space and on the Moon in Mission 1 of the HAKUTO-R program, and the two batteries were confirmed working normally in outer space. We will test the operation of these batteries also on the Moon after lunar landing.

Based on these results, we will continue to improve the performance of solid-state batteries and battery materials (solid electrolytes) in order to realize all the possibilities of solid-state batteries in the future.

■Comment from Keiji Suzuki, Executive Officer, R&D Division

With our oxide ceramic-based solid-state battery materials proven working effectively in harsh

environments such as outer space, the effectiveness of secondary batteries in the aerospace industry and other harsh environments will also be proven. Such findings will expand the range of applications of solid-state battery, as a next-generation of liquid lithium-ion battery, in addition to the current application for electric vehicles, and as a result, will increase the potential of oxide ceramic-based solid electrolytes as well. By providing such materials and technologies to the world, we will deepen our contribution to an alternative energy society.

■See the following website for details of the launch
ispace, inc. press release: https://ispace-inc.com/news-en

■About HAKUTO-R corporate partnership
See our press release on February 22, 2019:
https://www.ngkntk.co.jp/english/news/detail/001877.html
*Please note that the schedule and contents listed here are those of the original plan and have been changed.