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Examination of corrosion acceleration test method for electronic devices by sulfur gas

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Many chip components such as chip resistors are used in electronic components of automobiles. In recent years, chip LEDs have come to be widely used in order to improve fuel efficiency and the production of interior space. Silver is used inside these chip resistors and LEDs, and reacting with sulfur gas may cause disconnection inside the chip resistors and LED non-lighting. Therefore, at present, in order to confirm the resistance to sulfurization corrosion, we are conducting it under our own test conditions, but the problem is that the test time is long. In this study, we examined the shortening of the test time with reference to the international standard.

As shown in the chemical reaction formula, H_2S reacts through moisture, so it accelerates corrosion due to humidity. On the other hand, the characteristic of S_8 is that it reacts without water, so it has higher corrosive power than H_2S gas. It is also known that humidity does not have the effect of promoting corrosion.

At present, we are implementing A method: H_2S, which is our own condition that can reproduce the failure with H_2S gas, but 3000h is required. In order to shorten the test time, two tests (B method: S_8, C method: H_2S mixed gas) were examined with reference to international standards. (Table1)

Three types of test samples were used: chip resistors, LEDs, and silver plates. The chip resistance failure time of each test was 300h for the B method, 1000h for the C method, and 1500h for the A method. The LED did not fail with the A method 1500h. Next, we estimated the LED failure time by using the fact that the amount of increase in corrosion of the silver plate is proportional to the time. Specifically, the failure time of the LED of method A method was estimated to be 3334h by a simple regression equation with the corrosion increase amount of 4 mg as the failure time.

The failure time was arranged for each test method. (Fig.1)

From this result, it can be said that the chip resistance and LED failure can be reproduced in a shorter time in both the B method and the C method than in the A method. Method B can test S_8 gas from sulfur crosslinked rubber in the shortest time, and Method C can test S_8 gas including H_2S gas in the shortest time. In addition, it was proved that the A method (H_2S gas) requires a long test because it is more difficult to permeate than S_8 due to the intramolecular force of silicone.

We have realized a test method that is close to international standards and have contributed to the realization of a carbon-neutral society. (Fig.2)

Table1 Sulfur gas test plan

	Gas concentration [ppm]			Temperature [℃]	Relative humidity [%]	Test time [h]	Reference standerd
	H_2S	NO_2	S_8				
H_2S Gas test (A method)	8	-	-	25-60	60-95	3000	-
S_8 Gas test (B method)	-	-	6.8	90	Normal humidity	1000	ASTM B809-95
Mixed Gas test (C method)	2	4	(0.1)	40	75	1500	IEC 60747-5-6

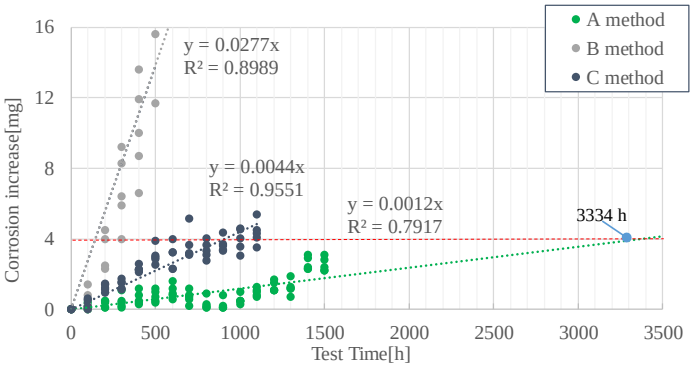

Fig.1 Corrosion increase

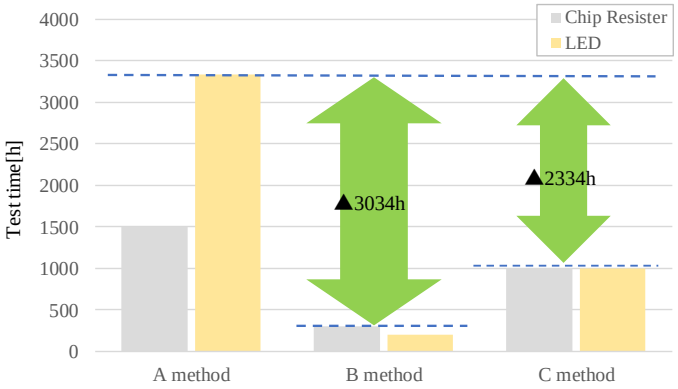

Fig.2 Reproduction time