Development of a CuW Contact Material with Excellent Crack Resistance for GCB

耐クラック性に優れたGCB用CuW電極材料の開発

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Key words; Large current interruption, arc, crack, crack resistance, copper-tungsten alloy, tungsten grain size, GCB (gus circuit breaker)

キーワード；大電流遮断、アーク、割れ、耐クラック性、銅タングステン、タングステン粒径、ガス絶縁開閉装置

Abstract

Copper-tungsten contacts are known to have hexagonal-shaped cracks on the surface due to thermal shock of arc when interrupting a large current. These cracks are likely to be cathode spots and accelerate the contact erosion as well as hindering extinction of arc. In addition, such cracks stretch to the inside of the contact in an alternating succession of current interruption, and eventually the contact becomes defective. This time, we report our newly developed contact material which has fewer cracks when interrupting a large current.

銅タングステン接点は大電流を遮断するとアークの熱衝撃により表面に亀甲状の割れが発生することが知られている。この割れの部分は陰極点になりやすく、消弧の妨げになるとともに接点消耗を加速させる。また、電流遮断を繰り返すとその割れは接点内部へ伸展し、最終的には接点が欠損する。この度、大電流遮断時に発生する割れが少ない新しい接点材料を開発したので報告する。

1.Introduction

This time, we report our newly developed contact material which has fewer cracks when interrupting a large current.

Copper-tungsten contacts are known to have hexagonal-shaped cracks on the surface due to thermal shock of arc when interrupting a large current. These cracks are likely to be cathode spots and accelerate the contact erosion as well as hindering extinction of arc. In addition, such cracks stretch to the inside of the contact in an alternating succession of current interruption, and eventually the contact becomes defective.

We developed a new contact material using tungsten whose particle size is larger than ever in order to eliminate the occurrence of cracks at the time of large current interruption.

2.Experimental

2.1 About the contacts

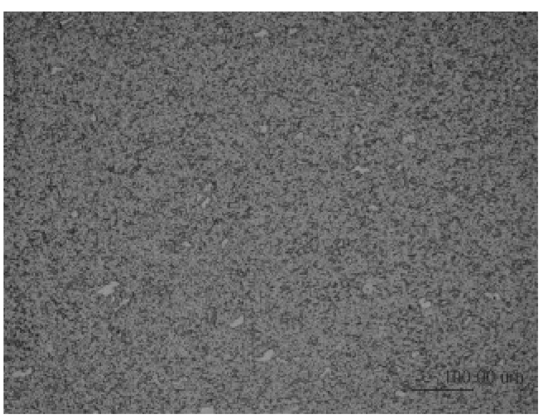
Physical properties and the copper content of contacts used are shown in Table 1. Structure photographs of them are shown in Figure 1. These contacts were fabricated by infiltration method. C30A2 is a traditional material of copper-tungsten alloy.

Table.1 Physical properties and the copper content of contacts used

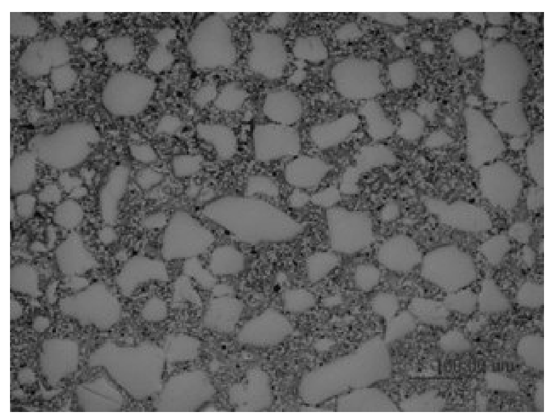
	specific gravity	Hardness (HRB)	Electrical Conductivity (IACS%)	Copper content (mass%)
C30A2	14.2	93	43 over	30
a new contact material	14.7	105(*2)	39(*2)	26.2(*2)

*1 Each value of C30A2 is typical one

*2 Estimate values based on lot test data



C30A2



A new contact material

Fig.1 Structure photographs of contacts used

2.2 Short-circuit interruption test

We carried out a short-circuit interruption test using electromagnetic repulsion and evaluated the surface, cross-section and erosion of contacts. The schematic diagram of the test is shown in Fig. 2. A half-wave voltage of the phase controlled by SCR is applied between a pair of contacts to generate electromagnetic repulsive force which separates the contacts. The test conditions are as shown below:

Contact size: 2 x 5 x 5 mm

Voltage: AC230 V

Current: 2,500 A (peak)

The number of cutoffs: 5 (30 seconds each)

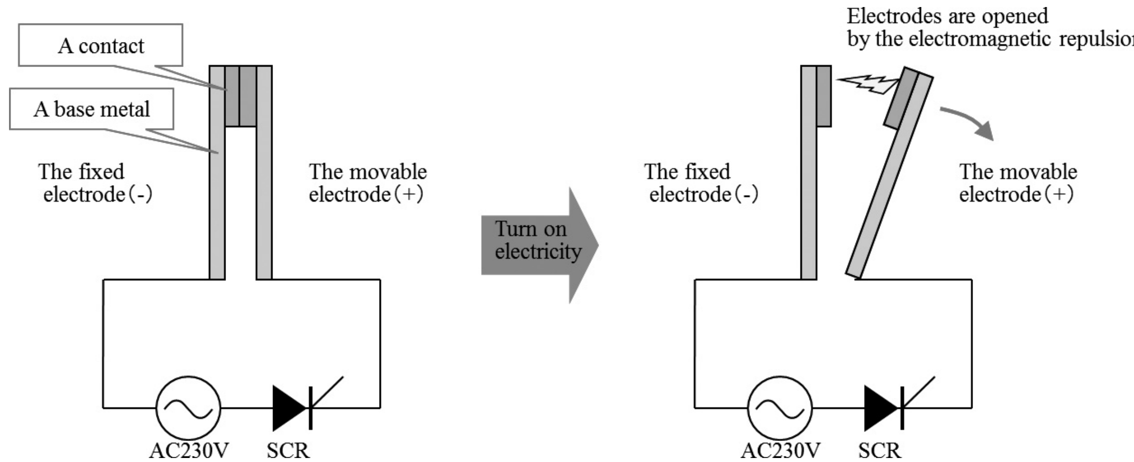


Fig. 2 Schematic diagram of the short-circuit interruption test

3.Results and Discussion

3.1 Observation of contact’ s surface and cross section after the test

The photographs of contact’s surface and cross section after the test are shown in Fig. 3.

Hexagonal-shaped cracks on the surface of C30A2 are observed remarkably. However, the new contact material hardly shows them. In the cross section, cracks of C30A2 stretch substantially vertical to inside. However, the new contact material shows no stretching crack.

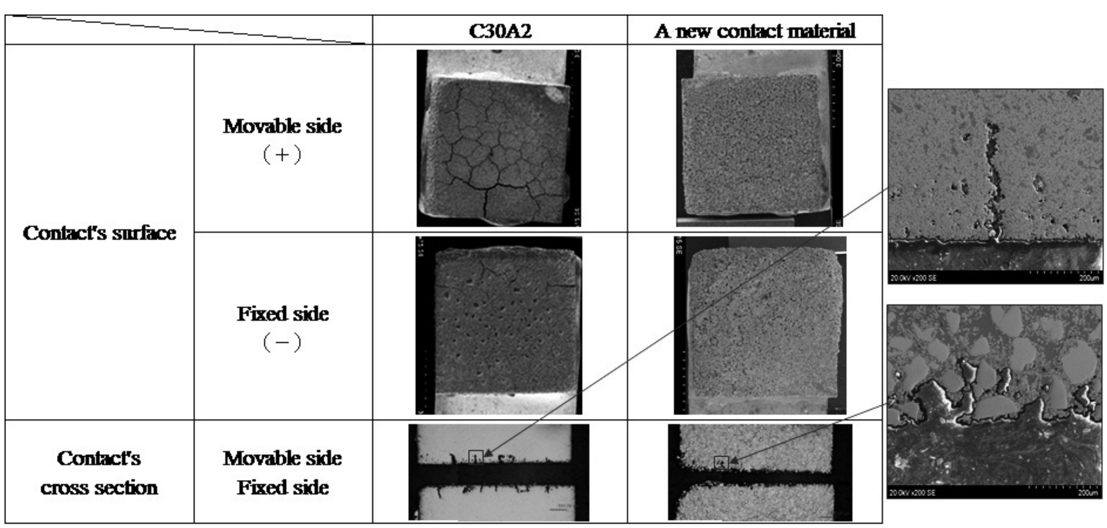


Fig.3 Photographs of contact’s surface and cross section after the test

3.2 The contact erosion and the cumulative length of cracks seen on the cross section

The contact erosion and the accumulated length of cracks seen on the cross section after a short circuit interruption test are shown in Fig. 4. The erosion of the new contact material increases by about 10% in total compared with C30A2. However, the accumulated length of cracks on the cross section is about 17% of C30A2.

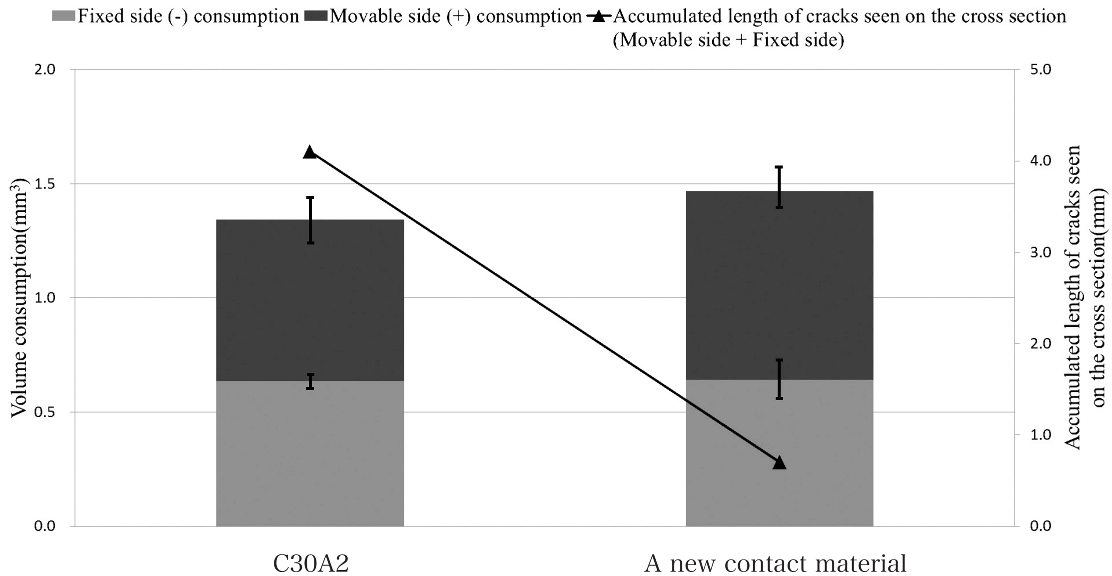


Fig.4 The contact erosion and the accumulated length of cracks seen on the cross section after a short-circuit interruption test

3.3 Discussions

It is considered that cracks of C30A2 stretch approximately linearly from the surface to the depth direction through copper particles between tungsten particles as shown in Fig. 5. In contrast, cracks of a new contact material stretch in a zigzag manner through copper particles along tungsten particles as shown in Fig. 6.

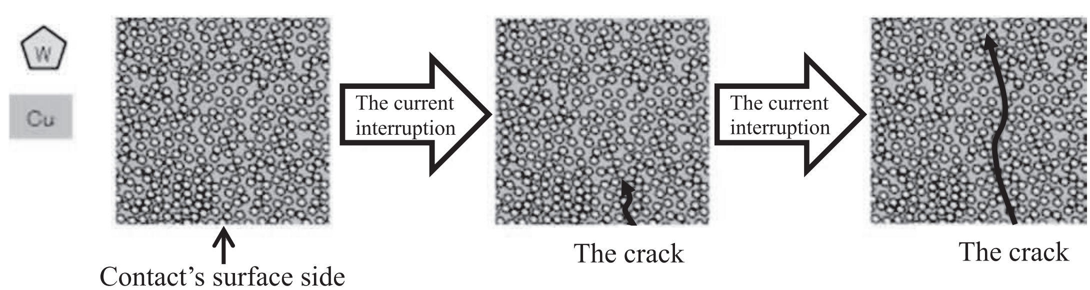


Fig.5 Image of a crack on C30A2

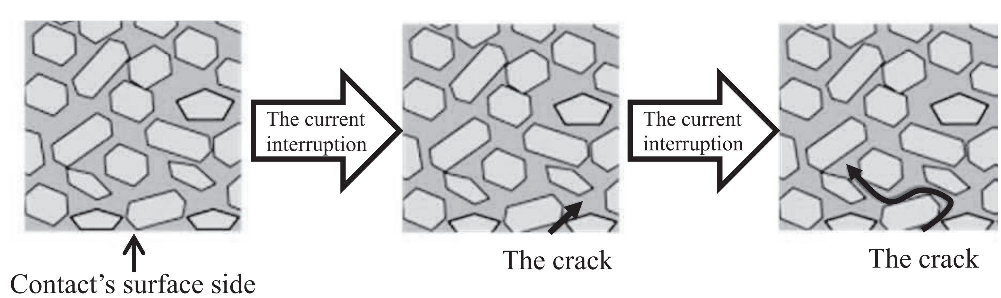


Fig.6 Image of a crack on the new contact material

4.Conclusions

It was confirmed that it is possible to reduce cracks after the current interruption by using larger tungsten particles in this test.

We believe that the use of such material for a contact for switchgear like GCB contributes to the improvement of its interruption performance.