Arc Erosion of Silver Alloy Contact Materials

Electro-Mechanical Research Group

Dr J.W. McBride
Electro-Mechanical Research Group
School of Engineering Science
University of Southampton
Southampton SO17 1BJ. UK.
Telephone: +44 (0) 2380 592895
Fax: +44 (0) 2380 593053
E-mail: jwm@soton.ac.uk

There are two major concerns with electrical switches and switchgear: erosion of the contact material on make and break (closing and opening the contact pair), and contact welding which prevents switching taking place. The amount of erosion dictates the useful lifetime of the contact pair and occurs due to material transfer by several phenomena, the arc discharge being the most dominant for opening under electrical load.

A purpose built apparatus has been used to conduct horizontal break opening operations on pairs of contact samples. The rate of operation was set to 8 per minute, at an opening velocity of 0.1m/s. Figure 1 indicates the extent of arc erosion that can occur on contacts. The figure is of a cathode Ag/CdO contact which has undergone 5000 break operations at 16A with a 60V power supply. Extensive melting has occurred with material removal from the centre of the cathode and deposition around the periphery.

Three different contact materials have been investigated, Ag/CdO, Ag/SnO_2 and Ag/Ni, on the break testing apparatus under electrical load. Mass measurements were taken of contact before and after 5000 break operations. Figure 2 shows the mass change results for these materials at different current loading.

Both anodes and cathodes mass changes are plotted for one operation. It can be seen that the cathodes always lose material whereas all anodes gain material for currents below 14A. Ag/CdO and Ag/SnO_2 lose material above 14A.

Figure 3 shows the distribution of arc duration with particular operation number. The first one thousand operations and the last thousand operations are shown. This indicates how the contact material can deteriorate with use.

Figure 4 shows the arc energy per single operation for the three materials investigated. At higher current the arc discharge with Ag/SnO_2 contact material dissipates significantly more energy than the other materials. This correlates to the erosion rates of these materials.

The research is geared to gain a more in-depth understanding of the arc-contact erosion processes and to improve the performance of contacts in terms of anti-arc-erosion and anti-weld properties.

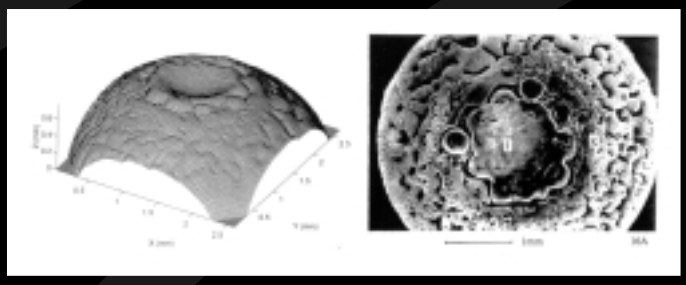

Figure 1: 3D Profile and SEM Micrograph of a Cathode having undergone 5000 Break Operations

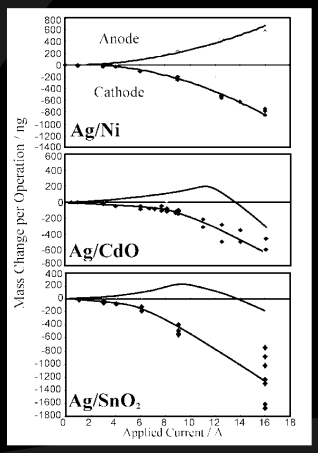

Figure 2: Mass Change on Contact Materials

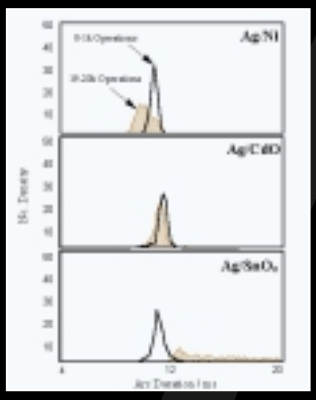

Figure 3: Arc Duration

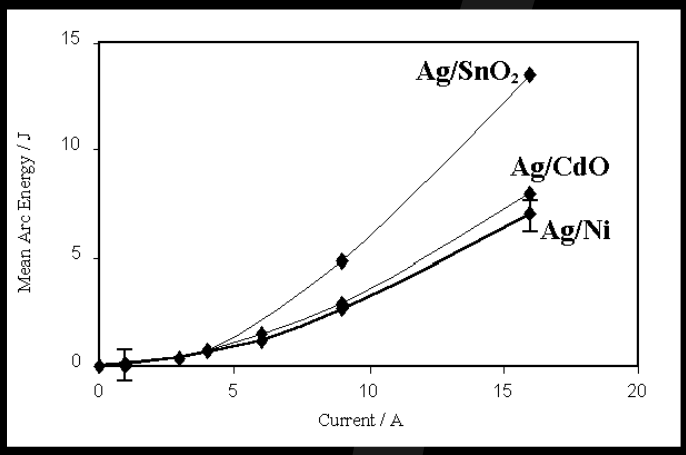

Figure 4: Arc Energy

University of Southampton