Title: Material effects on arc characterisitcs and electrical contact damage

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Electrical contacts used in automotive relays are degraded by electrical arcing occuring during turn on and off the switches. Prominent pips and craters may form on the surfaces of the electrical contacts. The formation of pips and craters is due to the material transfer between anode and cathode contact and closely related to the arc characterisitics occuring between two contacts. These surface erosion along with the formation of oxide and carbide compounds on the surface can cause switch failures. In this study, we investigated the effects of contact materials on the contact resistance and surface erosion. We found that not only contact materials but also contact arm (plate spring) materials have significant effects on the direction of material transfer between anode and cathode contact, hence the formation of pips and craters. Repetitive switching has been performed by applying a constant current of 9A and 20A at 12VDC with DC electronic load. Voltage drops were measured during the tests and the contact surface morphology and composition of the contacts were analyzed after 30,000 switching by using digital optical microscopy and energy-dispersive spectroscopy (EDS) in scanning electron microscopy (SEM), respectively. AgCu alloy and Ag-metal oxide contacts showed the formation of craters on cathod and pips on anode contact when BeCu alloy contact arm is used. Interestingly AgCu alloy contact attached on NiCu alloy contact arm showed the inverse material direction, i.e., prominant erosion occured on anode contact and material deposition observed on cathod contact. This phenomena will be discussed based on the measurement of the arc characteristics during contact closing and opening. The change of contact resistance and the formation of surface compounds will be compared among different contact materials.

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