

ON THE EROSION- AND ARC-RESISTANCE WHEN TESTED WITH DC- AND AC-STRESS BY THE EXAMPLE OF SILICONE ELASTOMERS

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Introduction

Silicone elastomer materials are established as housing materials for devices in middle- and high voltage outdoor applications. These materials are expected to be resistive against wet-pollution initiated surface discharges, to show an adequate resistance against tracking, erosion and low current arcing-activities. Both the inclined-plane-test according to IEC 60587 and the high voltage (HV) arc-test according to IEC 61621 are used to provide proof of this material property under AC stress. At this time it's not clear whether and to what extend the tests can be applied at dc and how the results are to be evaluated.

Inclined Plane Test

Investigation into the influence of the electrode material on the tracking and erosion performance under DC voltage is performed with a modified inclined plane test according to IEC 60587.

Parameter	Value
test voltage	3.5 kV DC+ at upper electrode
test time	2 h
flow rate	0.3 ml/min
upper electrode material	- Stainless steel - Platinum-iridium-alloy - Tungsten - Gold-plated tungsten

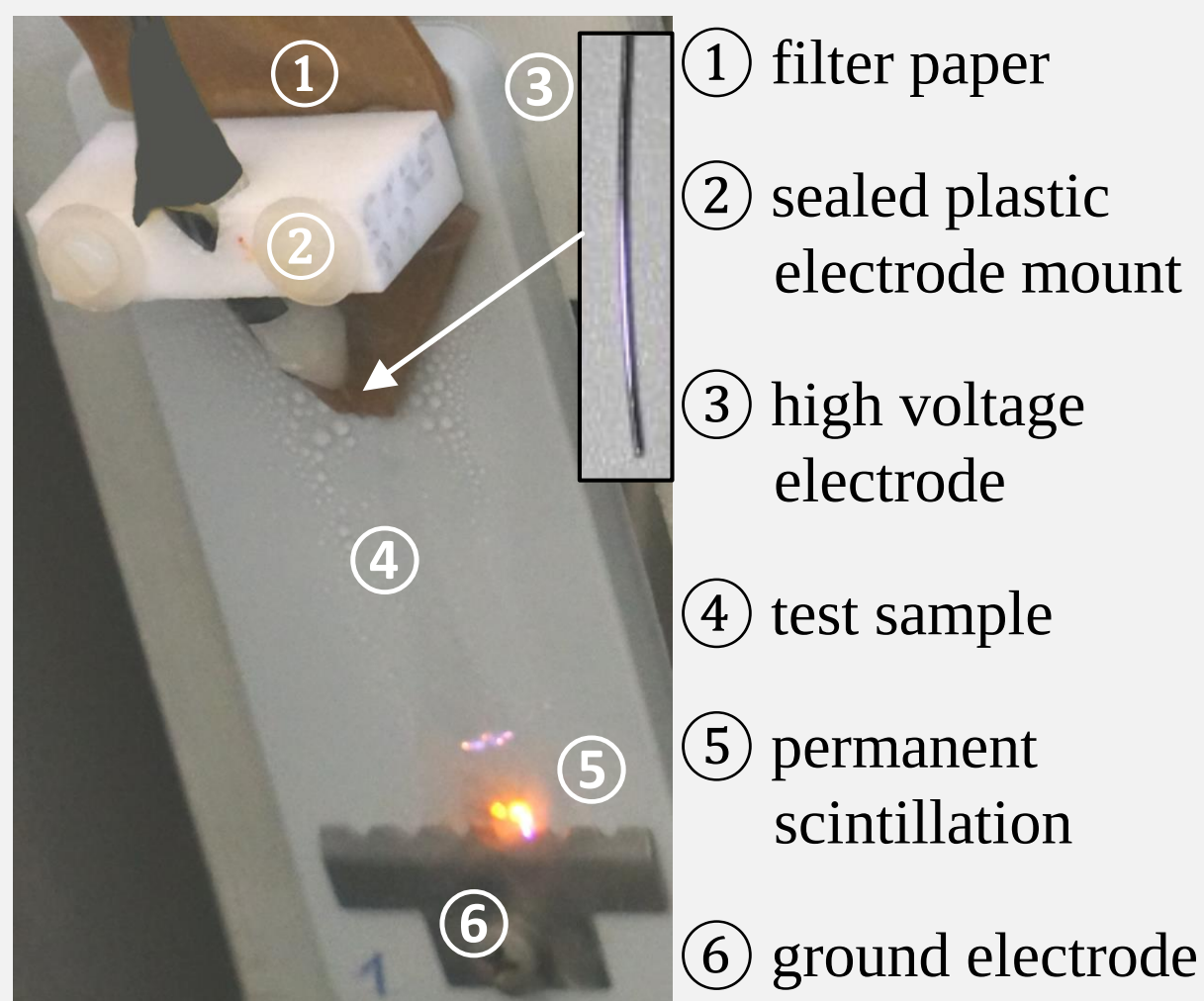


Fig. 1: Test parameters and test arrangement in the modified inclined plane test

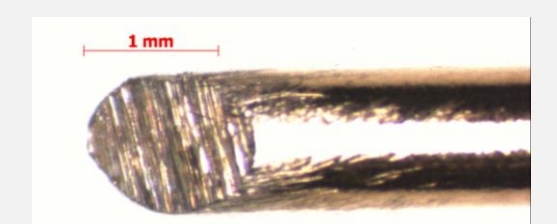
The electrodes are investigated by microscope and weighed before and after application to evaluate the corrosion resistance.

Stainless steel



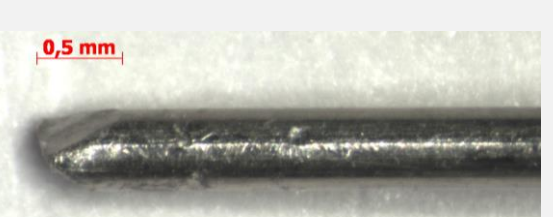
Material removal in form of pinhole-shape voids

Tungsten/ gold plated tungsten



Removal of gold coating and tungsten as for stainless steel

Platinum-iridium-alloy



No optical change or mass loss over a total test time of 40h

Fig. 2: Electrodes before and after a 2h inclined-plane-test with DC+

Only when using platinum-iridium no corrosion effects are visible. Nevertheless no statistically significant difference in the degradation of test specimens in dependence of electrode material is observed.

High Voltage Arc Test

When tested with the HV arc test, the specimens are stressed by a high-voltage low-current arc that is ignited between needle-type tungsten electrodes.

Parameter	Value
test voltage AC _{rms} / DC	12,5 kV
test current AC _{rms} / DC	10 mA - 40 mA
max. test time	420 s

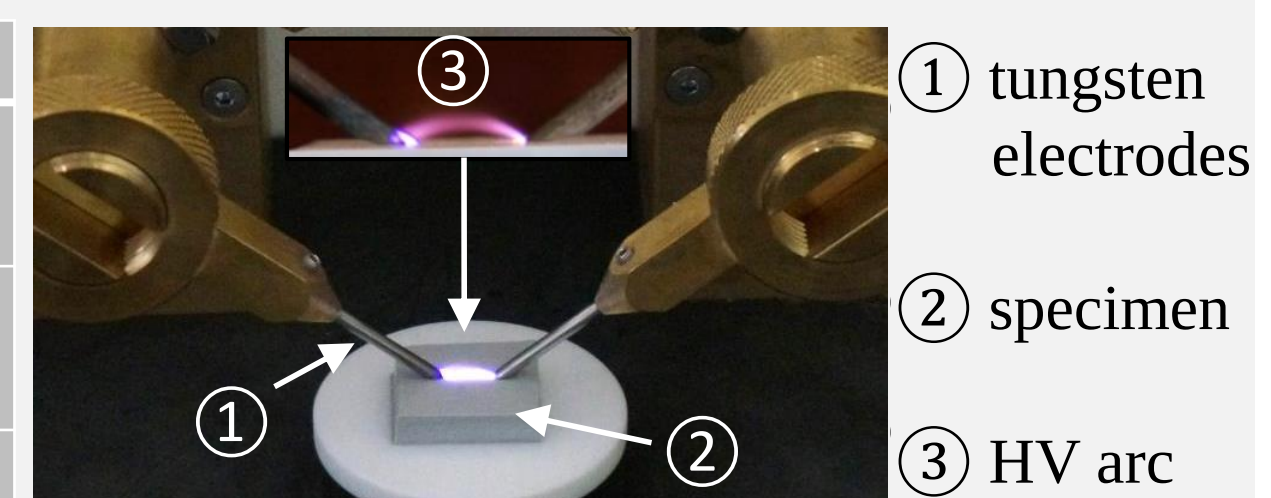
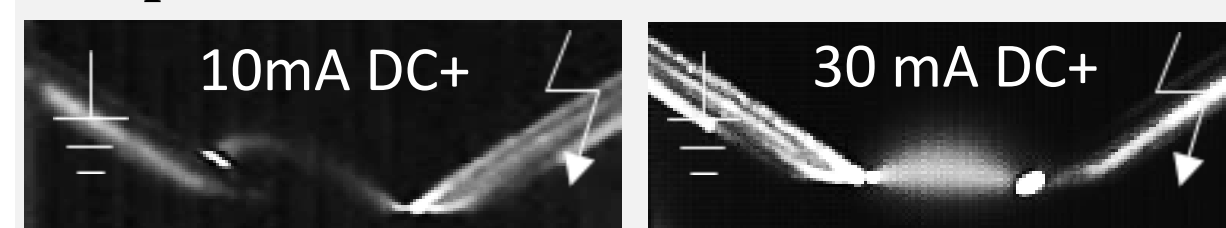
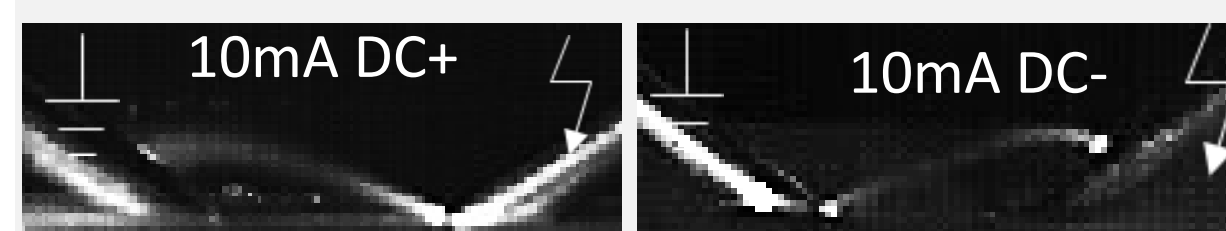


Fig. 3: Test parameters and electrode arrangement for the high voltage arc test

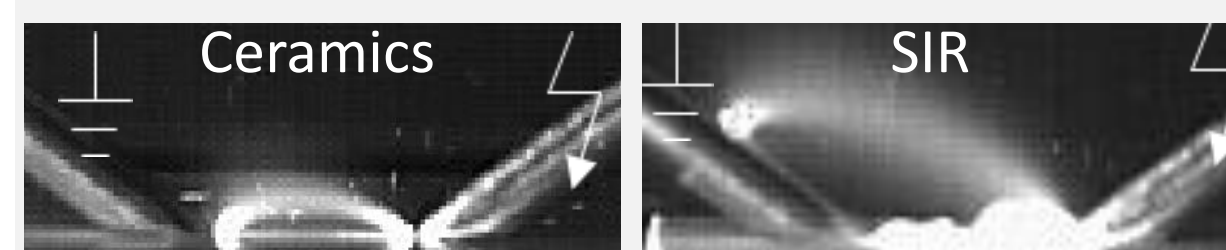
Investigations with a high-speed-camera show that the arc dynamic depends on several influential factors:



Arc current strength
with increasing current the stability of the arc increases



Voltage type/ polarity
highest mobility is located at the cathode depending on the polarity and voltage type



Tested material
influences the arc by out-gassing degradation products

Fig. 4: Arc dynamic in depending on arc current, polarity and tested material

Investigations to the influence of the voltage type are carried out with AC and DC+ voltage.

A material dependency of the arc withstand times between AC and DC stress can be noticed. Further the material ranking changes under DC in comparison to ac stress.

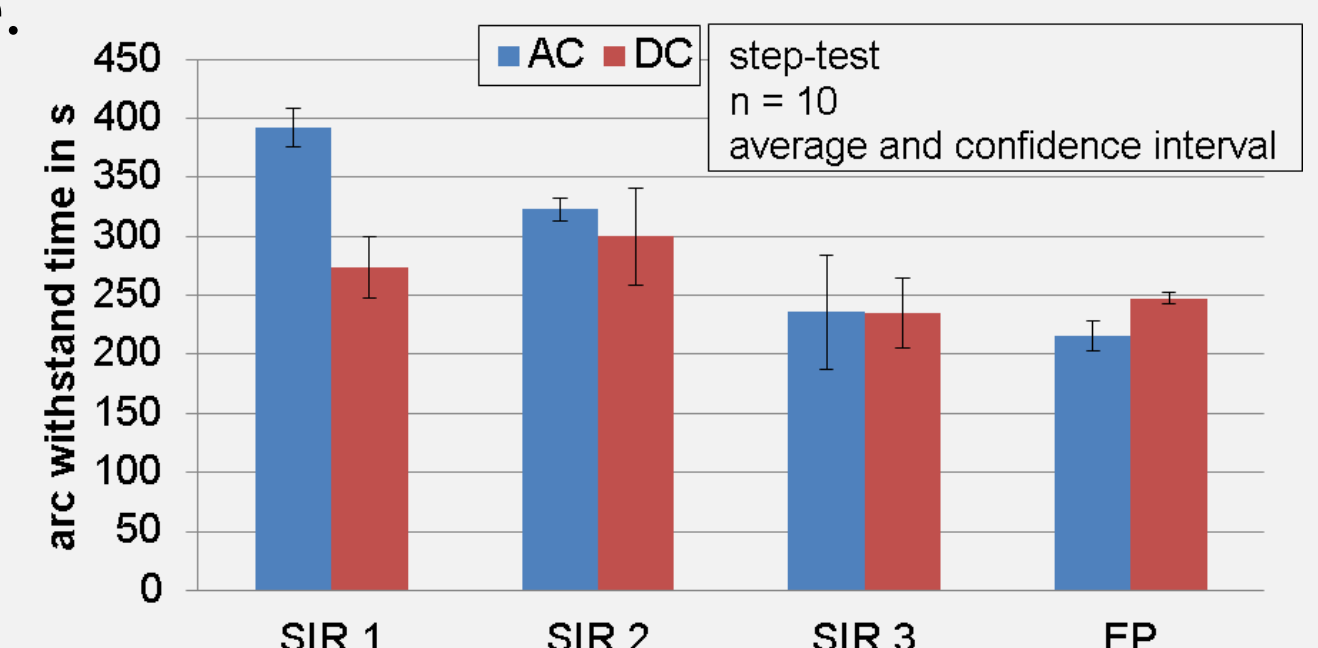


Fig. 5: Arc withstand times in comparison of AC and DC+ stress

Summary and Conclusions

Investigations regarding the corrosion resistance in the inclined plane test under dc stress shown that only the platinum-iridium-alloy shows no corrosion effects at all. Since there is no significant difference in the degradation of the test specimens it is assumed, that the influence of electrode corrosion is minor than e.g. the local and temporal stability of the pre-arcs.

Investigations to the high-voltage arc test revealed, that the arc dynamic depends on the arc current, the voltage type and the tested material itself. Further the differences of the arc withstand times between ac and dc are material depended. Thus the material ranking between ac and dc is different, what's been already noticed in previously investigations using the inclined plane test.