Adaptation of silver-based screen pastes to achieve stretchable, conductive patterns

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Introduction

Printed electronics on thin substrates are limited by fatigue induced defects resulting from stretching and bending. Within this project the influence of adding elastomers to standard silver screen pastes is investigated. Optimizations on both the elastomer-to-screen paste ratio as well as the curing procedure were performed along with stretch tests. The obtained results will be used in future work on the stretching and bending properties of light-emitting devices and sensors.

Mission

Elongate lifetime of stretched and/or bent conductive tracks not by smart pattern design but by ink formulation.

Procedure

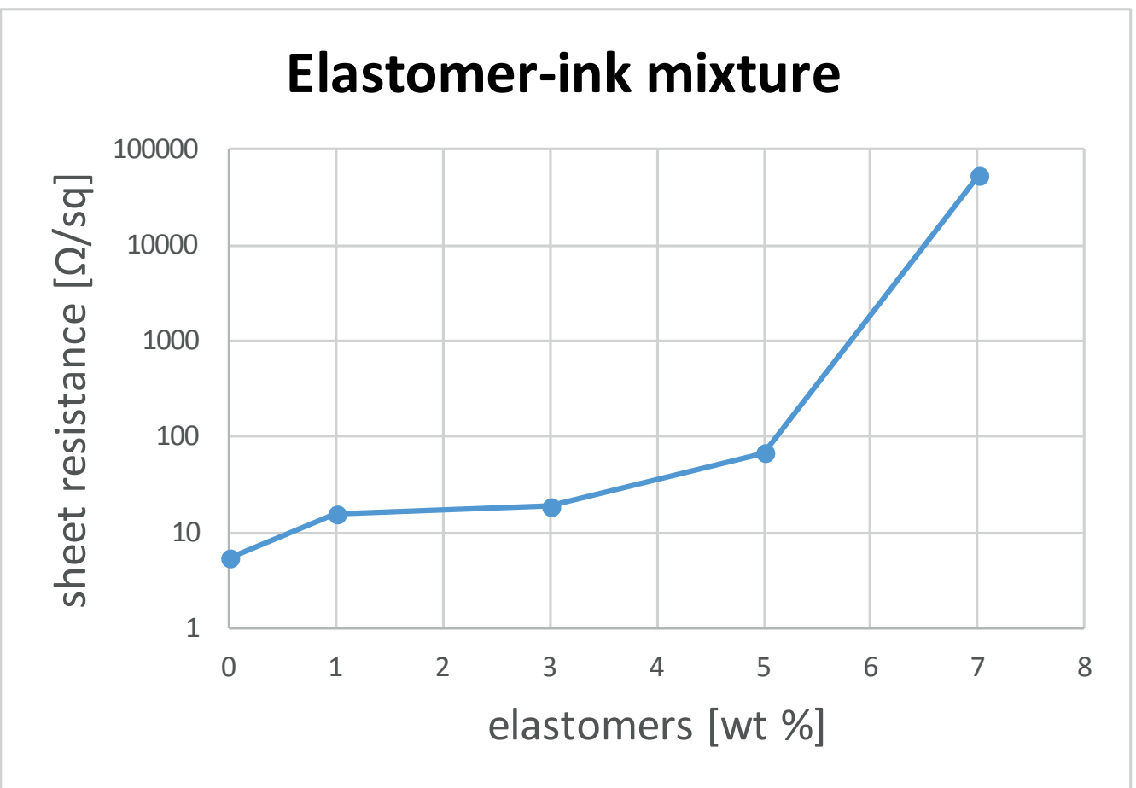
» different ratios of elastomers and commercially available Ag screen paste

» screen printed and sintered in a box oven @130°C

fig 1. Screen printing is used as the deposition technique of choice. IMO-IMOMEC has an Isimat 1000P (shown) at its disposal.

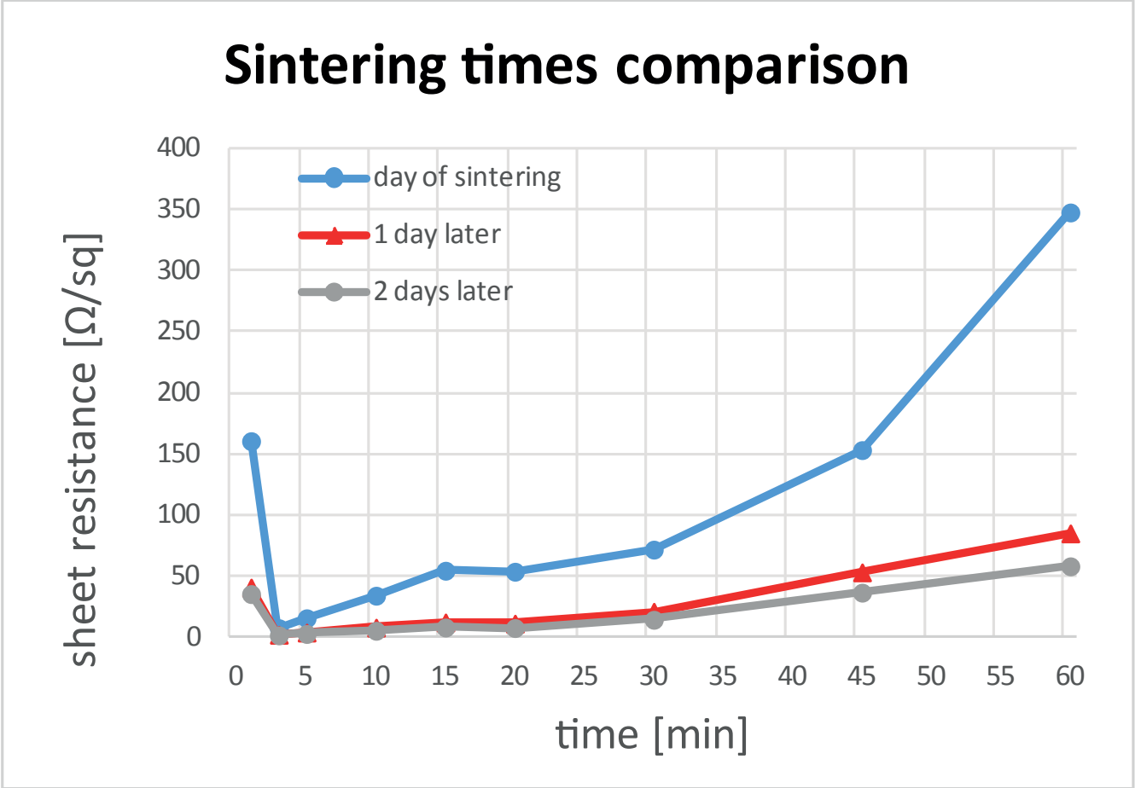
» optimal ratio

fig 2. Sheet resistance vs elastomer wt% of screen printed samples. The optimal amount of elastomers was found to be 3wt%.



» optimal sintering time

fig 3. Sheet resistance vs sintering time of screen printed samples. Lowest sheet resistance of 13Ω/sq is established after 3min of sintering.



» morphological influence of elastomers visualized by scanning electron microscopy (SEM)

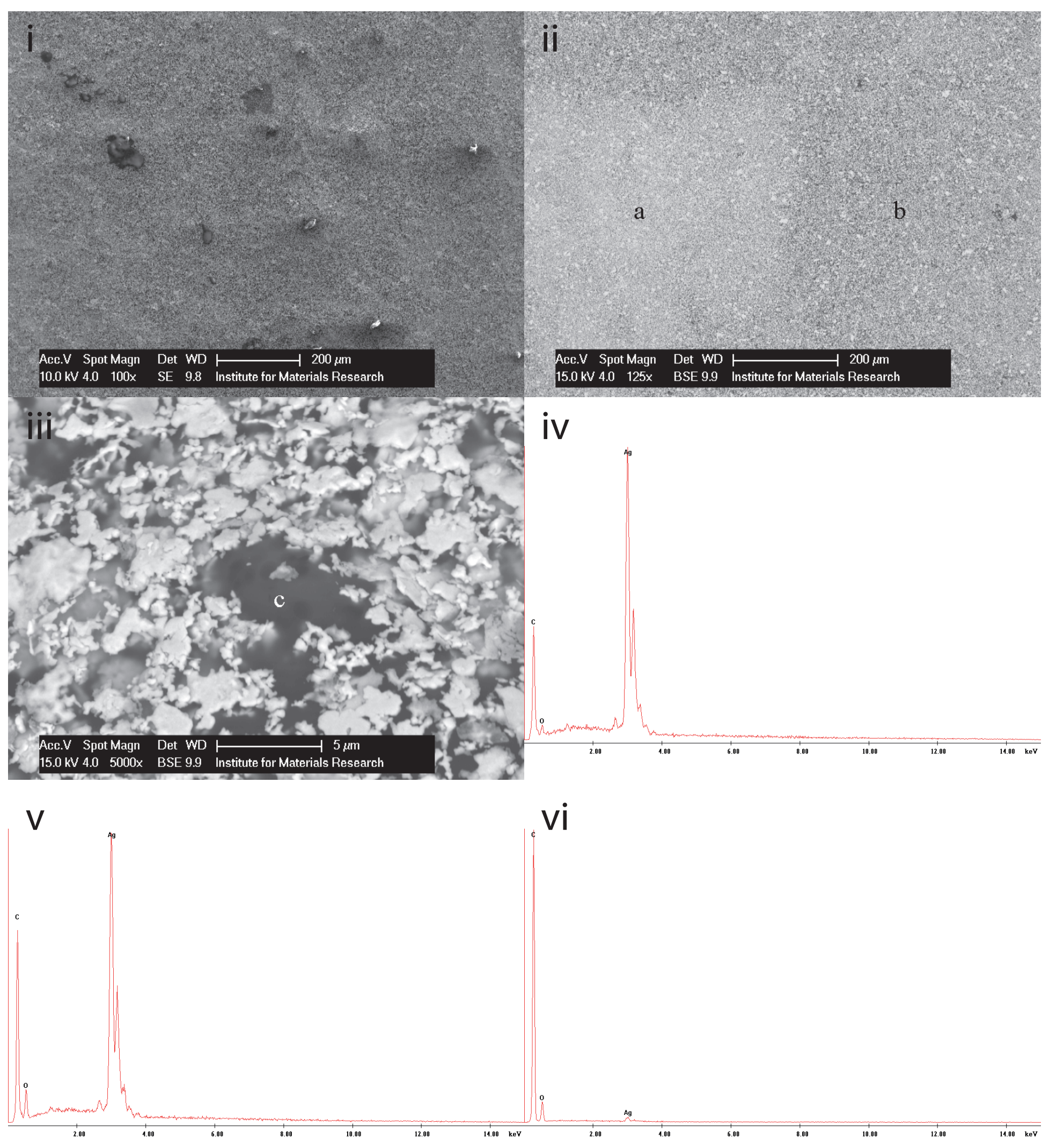


fig 4. SEM images of adapted ink samples showing (i) overview with different shaded regions and obvious dark spots (ii) overview with different shaded regions marked *a* and *b* (iii) detail of dark spot as region *c* (iv)(v)(vi) EDX at regions a, b and c indicating respectively: a - high Ag and low C (polymer) content, b - high Ag and increased C content, c - almost exclusively C content

More spots appear as elastomer wt% increases. It was concluded that these spots exist of pure elastomer.

» stretch tests: comparison of standard ink and adapted ink

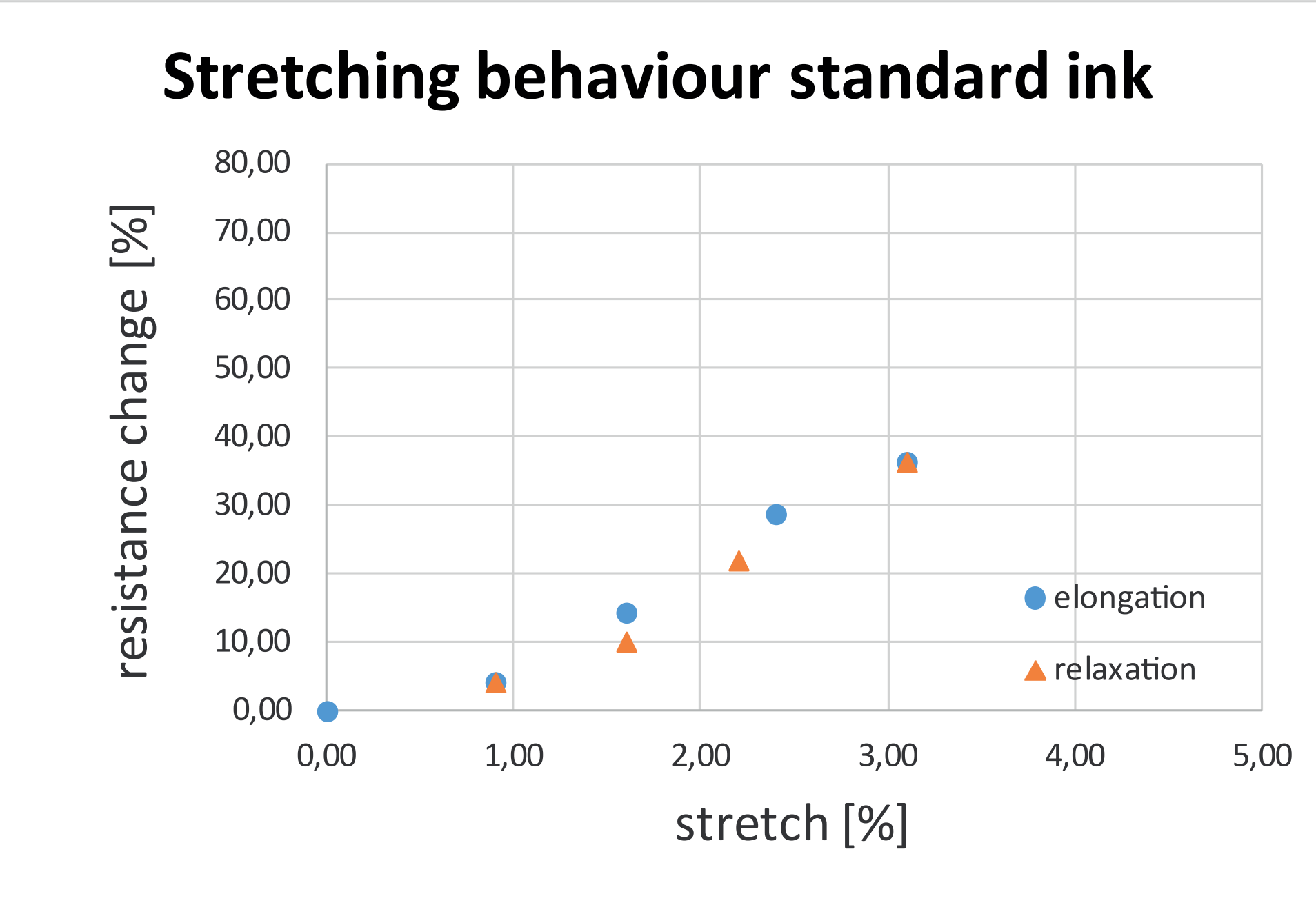


fig 5. Sheet resistance vs elongation for a screen printed straight line pattern of standard ink (Gwent C2090210P12). Stretching was only performed in the elastic region.

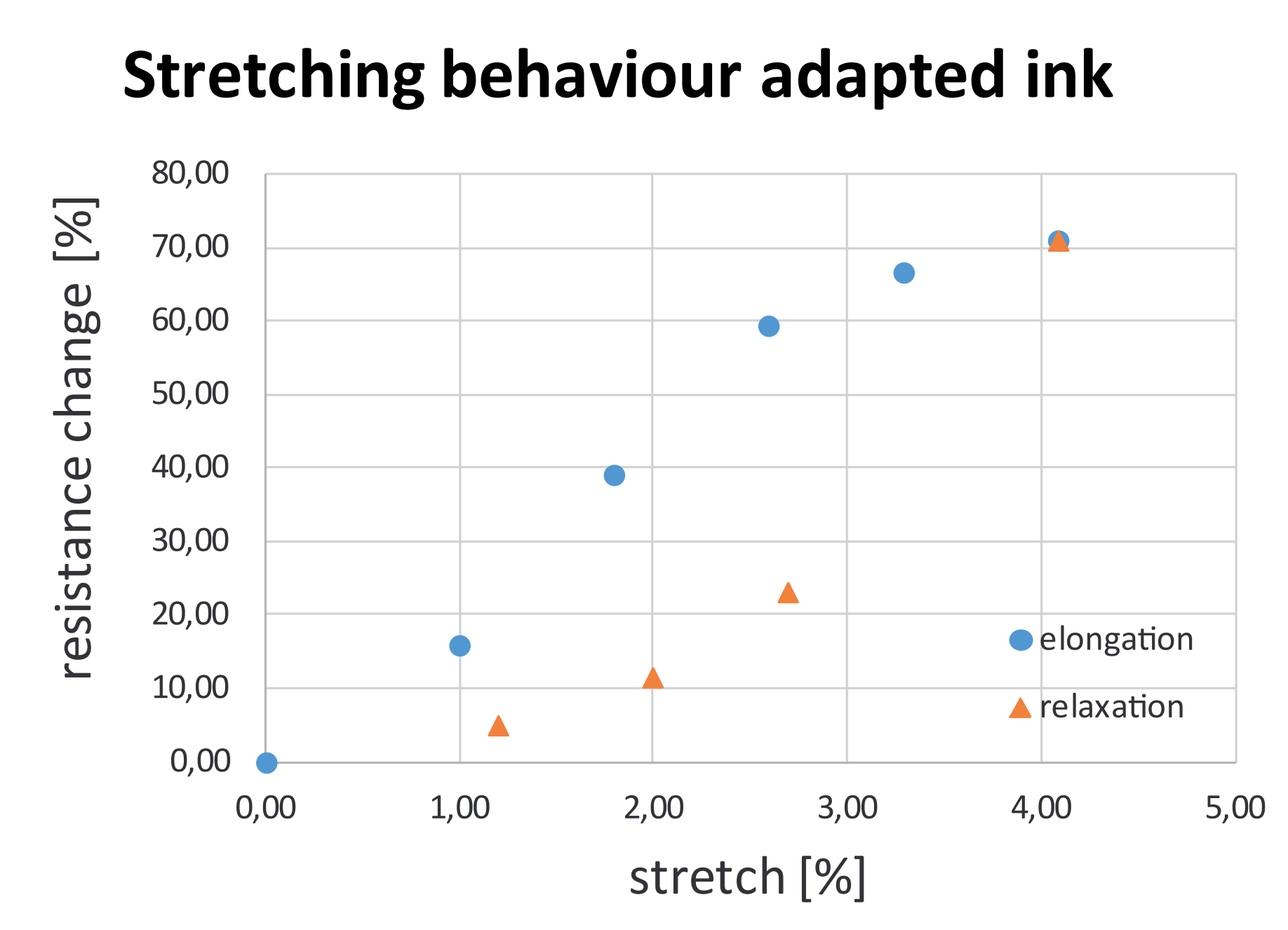


fig 6. Sheet resistance vs elongation for a screen printed straight line pattern of adapted ink (Gwent C2090210P12 + 3wt% elastomers). Elastomers are 5 wt% acrylates and 75 wt% plasticizers. Stretching was only performed in the elastic region.

Conclusion

» optimal ratio: 3wt%
» optimal t_{sinter}: 3min
» higher ΔR when stretched

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