Master's Thesis Engineering Technology

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Treatment of textiles in preparation for inkjet printing of conductive patterns

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Smart textiles

Research group FME at IMO-IMOMEC performs studies on the implementation of inkjet printing in the production of flexible electronics and smart textiles. In the inkjet printing on textiles, ink easily gets absorbed into the textile fibers, causing serious reduction of the print quality and conductivity. Ink absorption and migration (longitudinal spreading) had to be overcome to create conductive structures.

Treating textiles before printing

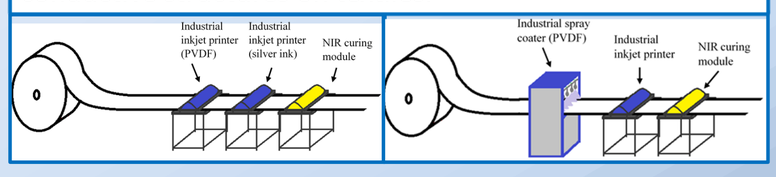
To overcome ink absorption, the textiles were treated prior to printing. Various treatments were tested on three different textiles (a woven textile (1), a non woven textile (2) and a woven and stretchable textile (3), all consistent of 100 % polyester). Silanization treatment, PVDF coating, two dielectric pastes (D2070209P6 white- and D2090130P5 pink paste), a low conductive carbon paste (ECI 8001 E&C), H1052 and PS film coating were all tested as pretreatments of the textile before applying the prints. The inkjet printing was performed with a Dimatix Materials Printer DMP-2831, using Metalon JS-A102 silver ink. This ink needed curing which was performed by oven curing at 143 °C, and by near infra red curing (NIR), since its hither compatibility with industrial applications. Because multilayer printing is possible and offers advantages on rough and/or porous substrates, prints were made varying between one till six layers of ink.

Results

The printed structures were multilayered squares measuring 4.5 by 4.5 mm. The results of the resistance, measured over a distance of 4 mm on these squares are given in figure 1 and 2 for textile 1, figure 3 and 4 for textile 2, and figure 5 and 6 for textile 3, respectively for oven curing (odd) and NIR curing (even). **PVDF** coating, when **uncured**, showed good results on textile 1 but failed on textile 2 and 3 (unwoven and stretchable textiles). The same conclusion accounted for **PVDF**, **cured** at 175 °C. PVDF coating was also very desirable given its high bio compatibility. **White dielectric paste** (D2070209P6) and **PS film** showed the best results over all textiles in general and were found to be good options when working towards wearable electronics. **Silanization** treatment was very good in preventing ink absorption, but created no conductive results due to complications during curing of the ink. **Other treatments** all found troubles somewhere throughout the printing process. An unintended discovery was made during the research, being the benefits of printing with ink at a **high temperature**. Something which calls for further investigation.

Conclusion

Some well-functioning treatments were identified in this masters thesis, mainly PVDF and PS film coating. The research also included suggestions for further research in this topic and a look into the industrial valorization of a roll-to-roll inkjet printing production line for printing conductive structures on textiles.



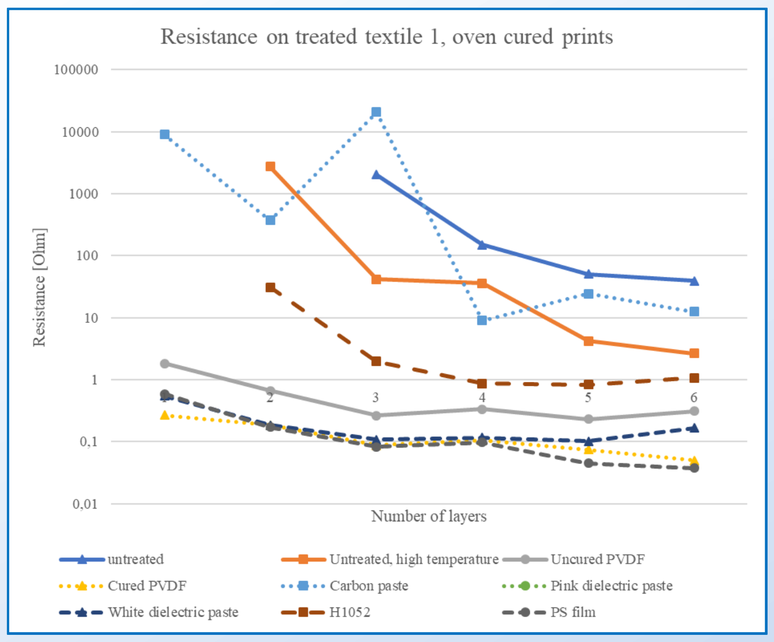


Figure 1: Resistance of the oven cured prints on textile 1 for the various treatments

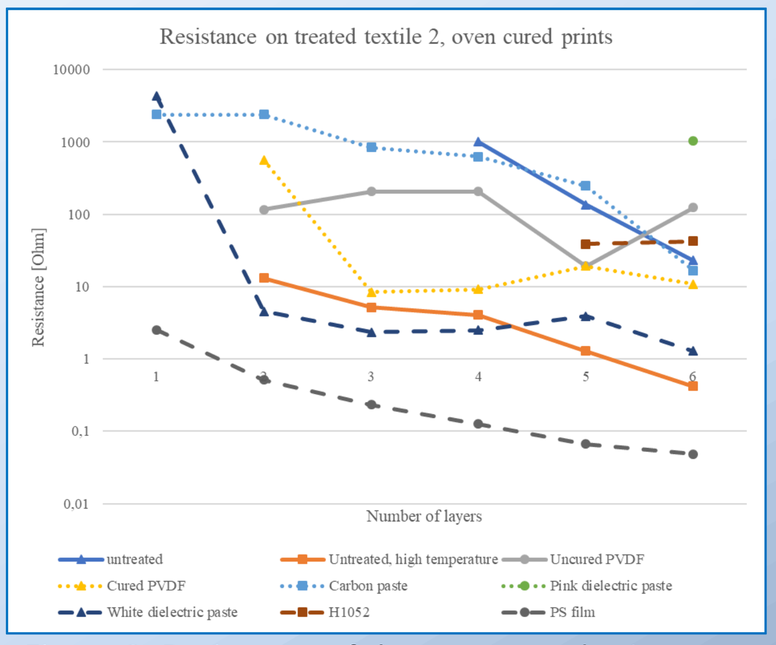


Figure 3: Resistance of the oven cured prints on textile 2 for the various treatments

Figure 5: Resistance of the oven cured prints on textile 3 for the various treatments

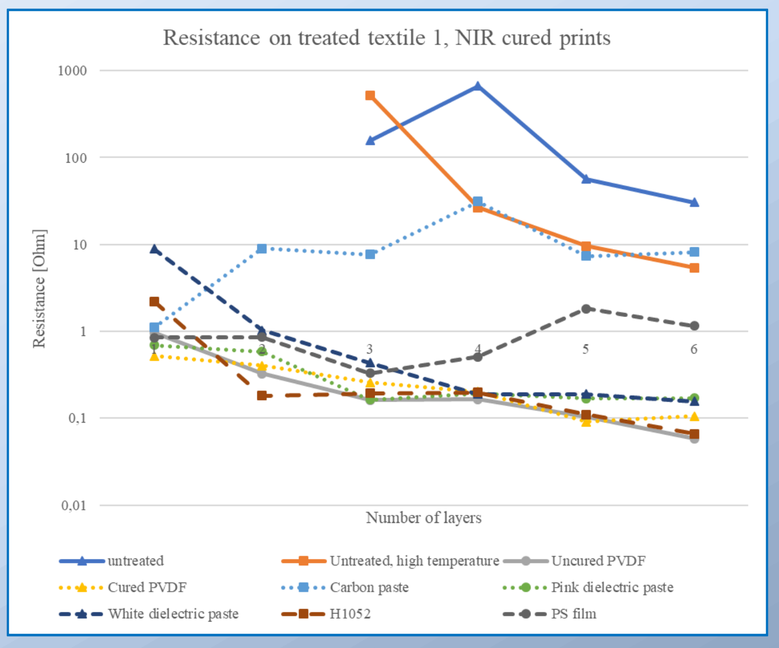


Figure 2: Resistance of the NIR cured prints on textile 1 for the various treatments

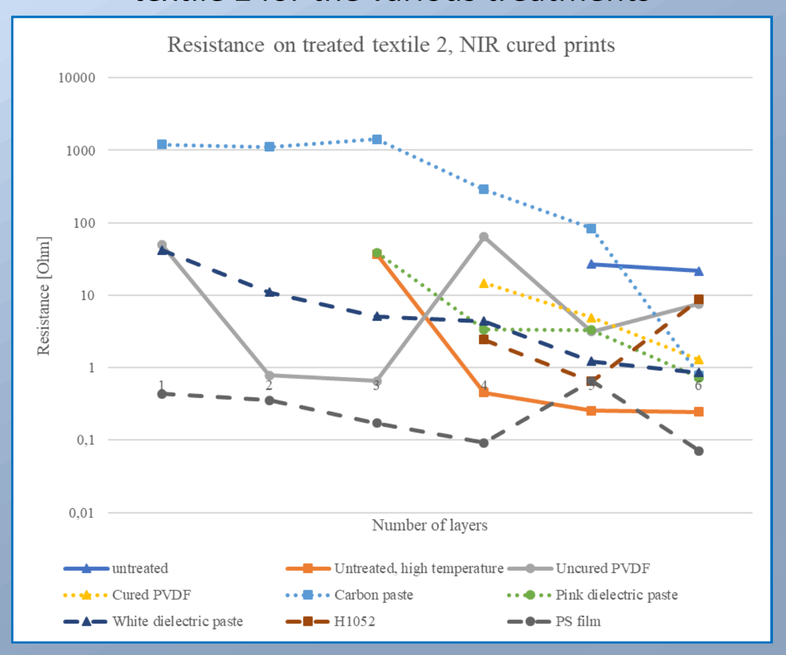


Figure 4: Resistance of the NIR cured prints on textile 2 for the various treatments

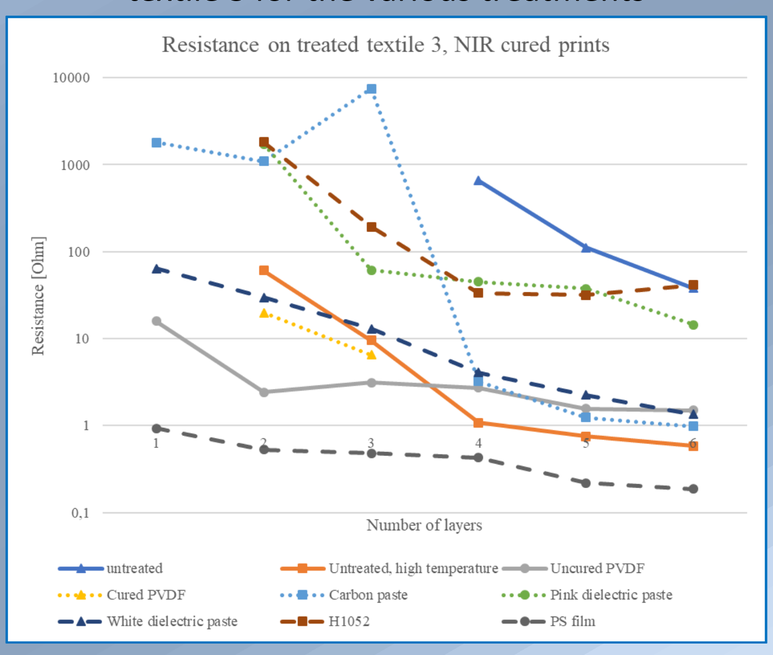


Figure 6: Resistance of the NIR cured prints on textile 3 for the various treatments

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