Sustainable Textile Electronics: Ink Formulation for Inkjet Printing Technology

DIEGO VAQUERO[1], JUNCHUN YU[1] AND VINCENT NIERSTRASZ[1]

1 TEXTILE MATERIALS TECHNOLOGY, DEPARTMENT OF TEXTILE TECHNOLOGY, FACULTY OF TEXTILES, ENGINEERING AND BUSINESS, UNIVERSITY OF BORAS, SE-501 90, BORÅS, SWEDEN

ABSTRACT

Textile electronics integrate electronic functionality directly into fabrics but raise sustainability concerns related to the increasing production of electronic components. The current research focuses on printing building blocks with inkjet printing as a resource efficient technology.

A water-based PEDOT:PSS ink (fig 1) was formulated for industrial printheads. The fabrication process (fig 2) results in deposition of the ink onto polyester textiles, maintaining conductivity without compromising textile properties. As expected, multiple printing passes (10-50) result in improved conductivity. Results show that different textile structure and direction of the printing, warp and weft direction (fig 3) affect the electric performance.

These findings highlight the importance of substrate selection and deposition control in producing printed textile electronics. This work contributes to scalable, sustainable solutions for smart textile applications.

MATERIALS

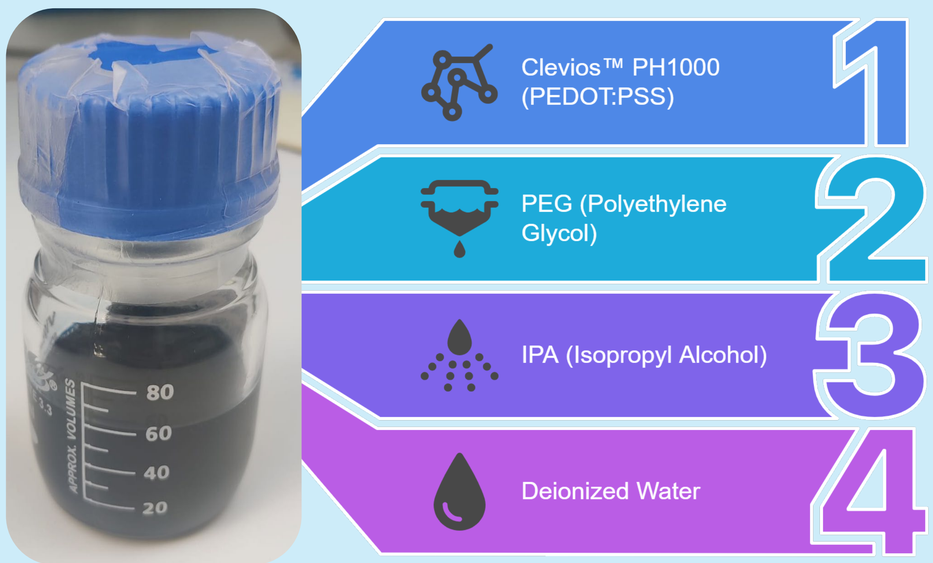

Fig 1. Formulated conductive ink with PEDOT:PSS

PROCESS

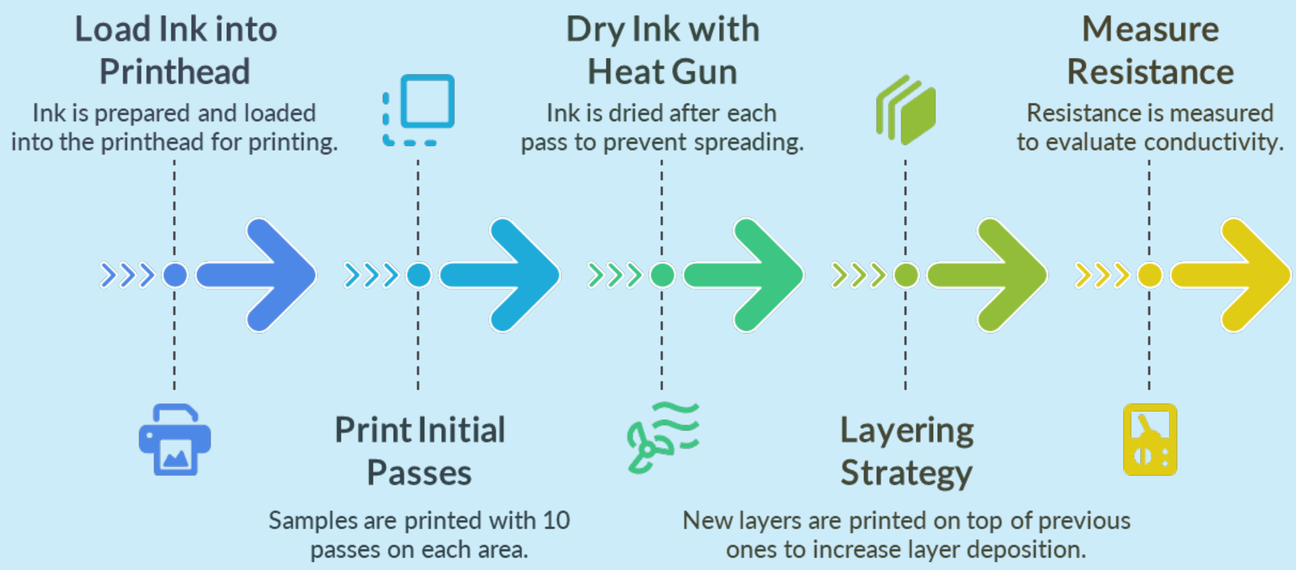

Fig 2. Inkjet printing process to evaluate electric performance

RESULTS

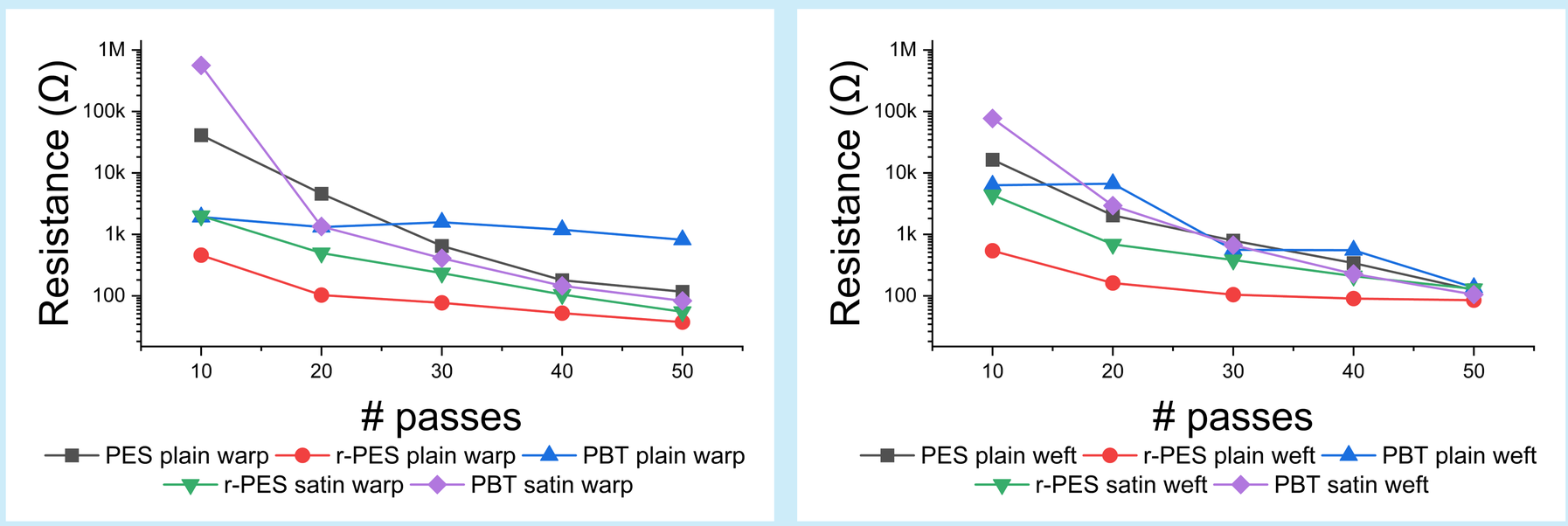

Fig 3. Resistance vs. number of printed passes for PES, r-PES and PBT fabrics and weave types: a) warp, b) weft

- The recycled polyester (r-PES) plain weave substrate exhibited the lowest resistance along the warp direction.
- The printed warp direction gives a lower resistance values than for the printed weft direction independent the fabric (PES, r-PES or PBT) and structure type (plain weave or satin weave).

CONCLUSION AND NEXT STEPS

Directional differences when characterizing the resistance were observed, with the warp direction consistently exhibiting lower values than the weft, attributed to textile roughness. Substrate type and weave structure also play a critical role; r-PES plain weave substrates demonstrated superior conductivity compared to PBT in both plain and satin weaves.

Future research includes benchmarking PEDOT:PSS against metallic and carbon-based inks and exploring multilayer printing strategies for printing building blocks to enhance conductivity and uniformity. Achieving sustainability depends on material selection, appropriate application and the implementation of an effective recovery process.

Contact Info

AACHEN DRESDEN DENKENDORF INTERNATIONAL TEXTILE CONFERENCE

European Commission

STELEC

UNIVERSITY OF BORÅS

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