Smart textiles have been a hot topic in research for several decades; however, comparatively few products can be found on the market. Resource-efficient processes can boost the breakthrough of smart and functional textiles, which often necessitate high-cost materials and only require small batches.

This thesis provides a technology-driven approach with resource-efficient solutions for the production of UV-sensing textiles, while pointing out the challenges of the new materials, which are created when novel production processes are used. The performance of UV-sensing textiles produced by ink jetting and UV curing of ink with commercial photochromic dyes is primarily explored. Several steps in the development of a UV-sensing textile are covered in thesis; development and jetting performance of the photochromic UV-curable inkjet ink, optimization of the color performance of photochromic prints using production process parameters by tuning color kinetics, and evaluation of the durability and textile character of photochromic textiles. Other focuses included in the thesis are dyeing of photochromic textiles with supercritical carbon dioxide ($scCO_2$), novel ways of stabilizing photochromic prints and ink jetting of functional ink for sports and work wear.

It was shown that physical properties of the ink and temperature affected the jetting behavior of the ink. A discrepancy between the drop formation of UV-curable photochromic ink and existing models for jetting of inkjet ink was highlighted. Reversibly color-changing textiles can be produced with inkjet printing and UV curing of photochromic inks. The combination of the resource-efficient processes with the photochromic material required the introduction of an extended kinetic model to describe the coloration reaction of prints. An essential finding was that the kinetics of photochromic dyes in UV-curable ink applied on polyester fabric could be tuned using fabrication parameters during printing and curing in a continuous resource-efficient production process. By changing fabrication parameters during production, the prints' crosslinking density is influenced and hence dye kinetics can be modified as a result of matrix rigidity of the UV ink. Furthermore, fabrication parameters influence and can be used to improve print durability as of abrasion and washing. Also, printing with photochromic UV-curable ink did not affect the fabric properties significantly in regards to flexibility and surface morphology. With the results obtained, photochromic textiles can be produced resource-efficiently using inkjet printing and UV curing, as well as $scCO_2$ dyeing to boost the cost-effective and flexible production of smart textile UV sensors.

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DOCTORAL THESIS

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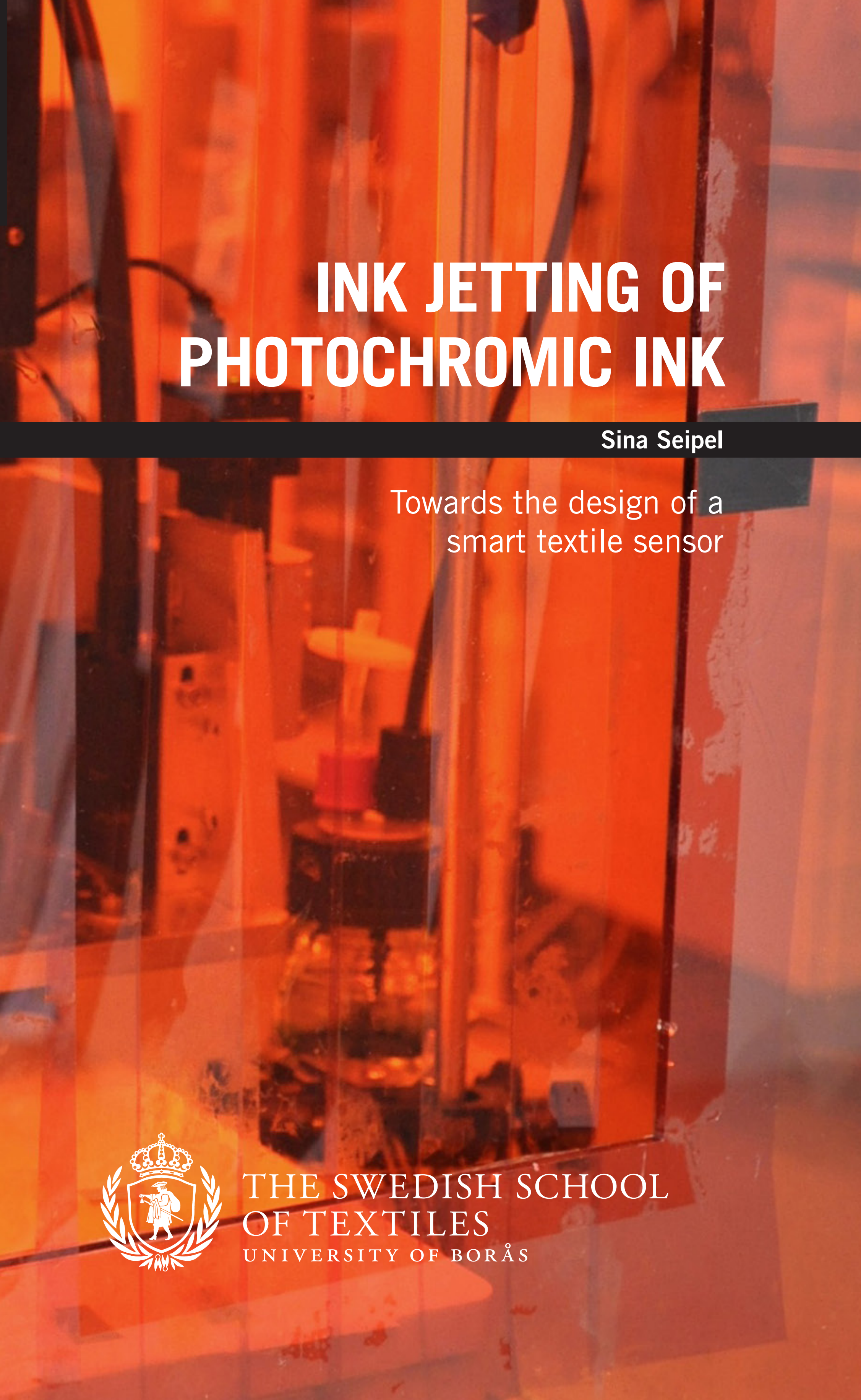
Textiles and Fashion



INK JETTING OF PHOTOCHROMIC INK

Sina Seipel

Towards the design of a smart textile sensor

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