LIFE CYCLE ANALYSIS OF PRINTED ELECTRONICS ON PAPER

Gael Depres looks at the development of eco-efficient smart electronics for anti-counterfeiting and shock detection based on printable inks

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Printed electronics are expected to meet an increasing demand for improved functionality and autonomy of products in the context of The Internet of Things. With this trend, the environmental performance of novel technologies is of growing importance.

The current study presents the life cycle assessment of two novel devices: an anti-counterfeit label based on the electrochromic display and a shock-detection tag based on the piezoelectric sensor, designed for the use in packaging of pharmaceuticals and luxury items to improve the safety and accountability in the supply chain.

"The devices are manufactured by means of energy-efficient printing techniques on a low-cost flexible and recyclable paper substrate"

ENERGY-EFFICIENT PRINTING TECHNIQUES

The devices are manufactured by means of energy-efficient printing techniques on a low-cost flexible and recyclable paper substrate. Comprehensive cradle-to-grave analysis contributes to industrial-scale energy and material life cycle inventories and identifies the main impact hotspots evaluated for a broad range of categories of the ReCiPe[1] midpoint (H) impact assessment method.

Results show that major impact burdens are associated with the near-field communication chip for the reduction of impacts of RFID [radio frequency identification] antenna, while the impacts of solvents, process energy, electrochromic display/piezoelectric sensor, Li-ion battery, and substrate are comparatively small. In terms of their global warming potential, both the anti-counterfeit label and shock-detection tag embody around 0.23kg of CO_2-equivalent.

REDUCING ENVIRONMENTAL IMPACT

Observations of these initial findings led to the development of several scenarios for the reduction of impacts of RFID antenna involving the flexography printing technique and substituting the silver ink with a copper-based nanoparticle ink. The development and investigation of these scenarios involved dedicated experimental work to reach a proof-of-concept and establish preliminary data necessary for modelling. Both scenarios result in a significant reduction of impacts particularly in toxicity-related categories and could play a significant role in the reduction of environmental impacts of new devices.

"Initial findings led to the development of scenarios involving the flexography printing technique"

We have also shown that the choice of the substrate has a small influence on the overall impacts of devices and that the paper substrate appears preferable in comparison with PET [polyethylene terephthalate]. ■

Sustainable paper substrate with printed silver ink and RFID antenna

1 *Often used in the Netherlands and Europe, the ReCiPe method for impact assessment in a life cycle analysis was first developed in 2008*

Read the full article here:
https://smartpapers.arjowiggins.com/life-cycle-analysis-of-printed-electronics-on-paper/

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