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THE DESIGN AND MANUFACTURING OF A PAPER-BASED E.COLI BIOSENSOR

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Abstract- Printed electronics employ additive manufacturing processes and has several application possibilities for bespoke or large area devices on flexible or inexpensive substrates. One of the most compelling applications of this technological advance is point-ofneed diagnostics. The intended use of the proposed paper-based E.coli (Escherichia coli) biosensor is low-resourced point-of-need markets and has been aligned with the ASSURED (affordable, sensitive, specific, user friendly, robust and rapid, equipment free and deliverable) guidelines of the World Health Organisation (WHO) for diagnostic tools. The paper-based E.coli biosensor is presented with the main focus being the refinement of the manufacturing process of a printed biosensor. The biosensor consists of interdigitated electrodes designed with a minimum feature size of 50µm, which were inkjet printed onto a paper substrate, using a nanoparticle silver ink. In this paper the design considerations, simulations and manufacturing of the biosensors are described. It is found that there are several manufacturing considerations that play a role, including conversion differences between different software layout formats, the physical printing parameters and ink properties that influence the minimum feature size as well as temperature curing challenges due to different material temperature coefficient expansion (TCE) rates. When considering a digital factory mind-map, this paper-based E.coli biosensor is still in its product development phase. However, by refining the manufacturing processes printed electronics not only allows for rapid-prototyping and effortlessly implementing design changes that accelerate the design process, but will also inherently accelerate large scale manufacturing in the future.