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Dear Editor,

Please find the enclosed manuscript entitled "**Oxide semiconductor based deep-subthreshold operated read-out electronics for all-printed smart sensor patches"** by J. R. Pradhan *et al.*, which, on behalf of all authors, I would like you to consider for publication in the journal "*Exploration*".

Over the previous decades, printed and flexible electronics is emerging as an alternative to mainstream Si-CMOS technology, especially to address applications that are either beyond or not relevant to the Si-technology to cater. In this regard, a large volume of Internet of Things (IoT) devices, or smart sensor patches can be talked about, which require an extremely large volume of devices to be produced, and therefore, very much compatible to high-throughput printing techniques. On the other hand, this refers to uncomplicated, but a large variety of different small circuit elements that must be produced, which may not anyway be easy for a silicon fab to handle. In case we focus on a specific application domain, i.e. smart sensor tags with read-out electronics, a large variety of sensors can be used in various needs of everyday life. This spans from chemical or gas sensors at the industrial premises, or for food and drug safety, to biosensors and medical diagnostic kits, and the electrochemical sensors that can be used for soil tests etc. However, the fundamental obstacle is that the literature reports of solution-processed analog front-end or read-out electronics is rare or nearly absent. This is due to the fact that the complexity of devices that the read-out electronics (specifically analog-to-digital converters, ADCs), or the wireless communication systems demand is certainly non-trivial to achieve with solution-processed/ printed thin film transistors (TFTs).

In this regard, in the present study, we have proposed and demonstrated a fully-printed and extremely simple 4 transistor 1-bit ADC unit, based on a-IGZO semiconductor material, which operates quite reliably under DC, as well as AC bias conditions, remains completely unaffected to atmospheric exposure for a month, and successfully digitalizes the real-time temperature sensor analog signals. On the other hand, to avoid complex wireless communication of the digitalized sensor signal an on-chip audio-visual demonstration of the sensor signal to cross a pre-defined threshold value has been planned, with an audio-visual recognition patch attached at the end of the smart sensor tag. The entire, fully-printed smart sensor tag is envisioned as a standalone unit, with on-chip energy sources, printed sensor and voltage divider unit, an amplifier, the ADC unit, a current drive circuit to generate high current/ power output for the visual recognition unit. In the present study, a chemically-driven color change of a material has been chosen to visualize the ADC switching event. The complete sensor patch may be used to determine a pre-defined critical threshold of a sensor reading that should be immediately communicated. On the other hand, when the change in the visual recognition unit is irreversible, for example, the chemically-induced color change of a material, demonstrated in this study, the sensor patch may also be used as an anti-counterfeit tag to detect tempering and/ or authenticity of a particular product. At the next step, multi-bit ADCs may also be fabricated following an identical protocol to further discretize the sensor signals.

The authors believe that the present work is a major advancement in the field of printed electronics and especially in the domain of printed smart sensor tags, and it may only receive the necessary attention it deserves, when it can be considered for publication in a highly-read journal, such as *Exploration*.

Finally, the corresponding author of this manuscript would like to point out that in 2022 we received an invitation from Dr. Guangchen Xu to submit an article in *Exploration*. While we had considered a particular work to submit in the journal, the communication got delayed when the first author of the article quickly relocated to the United Kingdom at short notice. In this context, when this article, originally submitted to *Advanced Materials*, received a transfer offer to Exploration, the authors believed that this may indeed be a good opportunity for this paper to be considered for publication in *Exploration*.

Looking forward to your response,

With warm Regards,

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