Supplementary Information (SI) for Journal of Materials Chemistry C.

A Wireless, Battery-Free Temperature Sensor Utilizing the Morphotropic Phase Boundary of $Hf_xZr_{1-x}O_2$ Thin Film

*Ketong Yang [a], Seungyeob Kim [a], Taeseung Jung [a], and Sanghun Jeon [a, *]*

a. School of electrical engineering, Korea Advanced Institute of Science and Technology, 291 Daehak-ro, Yuseong-gu, Daejeon 34141, Korea

*Corresponding authors: E-mail: jeonsh@kaist.ac.kr

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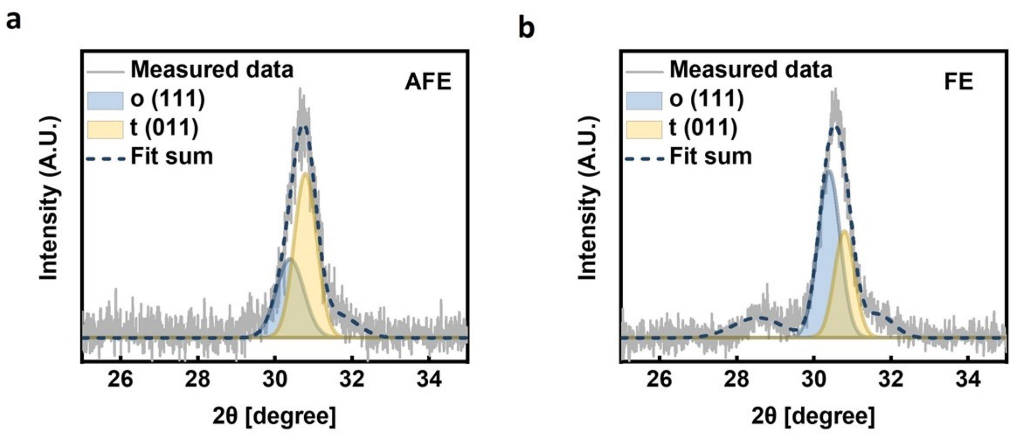

Figure S1. GIXRD of antiferroelectric and ferroelectric HZO films.

Figure S1a illustrates an antiferroelectric sample, in which the o-phase content is substantially lower than that of the t-phase. Conversely, Figure S1b depicts a ferroelectric sample, where the o-phase is predominant and surpasses the t-phase content.

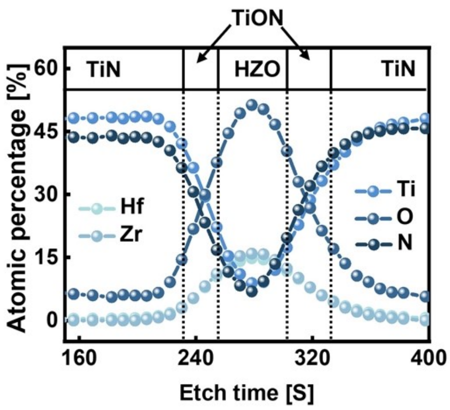

Figure S2. X-ray diffraction pattern of HZO films.

As etch time progresses, the sample exhibits a transition from TiN to TiON and subsequently to HZO. Furthermore, a relatively deep atomic diffusion at the bottom interface is observed, which is attributed to the unavoidable plasma-induced damage during the HZO deposition process.

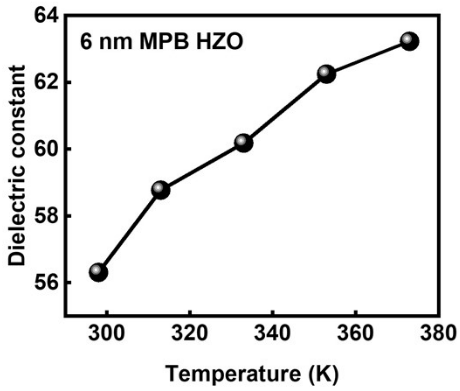

Figure S3. Dielectric constant as a function of the temperature.

The dielectric constant at E_C (0 V) increases from 56.3 at 297 K to 63.2 at 373 K.

Material	Integration	Temperature range	Wireless distance	Battery-Free	Reference #
Polyethylene Glycol	No	305 K- 315 K	16 mm	Yes	1
CNT/SnO_2	No	291 K- 298 K		No	2
PEDOT：PSS	No	303 K- 323 K		No	3
Plasmonic material TiN	Yes	293 K -373 K	No	No	4
BaTiO3	No	303 K- 323 K		Yes	5
PDMS-CF	No	293 K -373 K		Yes	6
PEDOT：PSS	No	293 K -378 K		Yes	7
$Hf_xZr_{1-x}O_2$	Yes	293 K -373 K	10 mm	Yes	This work

Table S1. Comparative analysis of existing wireless temperature sensors.

This table presents a comparison of key parameters of state-of-the-art temperature sensors developed over the past five years [1-7].

Reference

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