

TCAM-PUF with Enhanced Reliability for Hardware Security

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INTRODUCTION

- Electronics devices have become ubiquitous in day-to-day tasks.
- Security and privacy has become very crucial.
- Untrusted parties may access, steal, re-use the design illegally. So, hardware security is required for our day-to-day lives electronic devices.
- Physical unclonable function (PUF) sprouted up as a promising solution to enforce data privacy & access control to electronic devices.
- PUF circuits can be applied to various applications for authentication and secure key generation.



Fig 1: (a) Hardware Security for Electronic Devices (b) Different PUFs with Unique Characteristics

DESCRIPTION

- The responses in memory based PUFs are expected to be constant over repetitive operations.
- The environmental fluctuations may produce different responses compared to the expected response.
- To enhance the PUF reliability, we introduce a novel TCAM-PUF as shown in Fig. 2.
- Operation of the TCAM-PUF cell is as follows. When it is powered up, one of the three states ('0' or '1' or 'don't care') is stored in the TCAM cell and the additional don't care state is flipped to either logic '0' or logic '1' according to the environmental conditions.

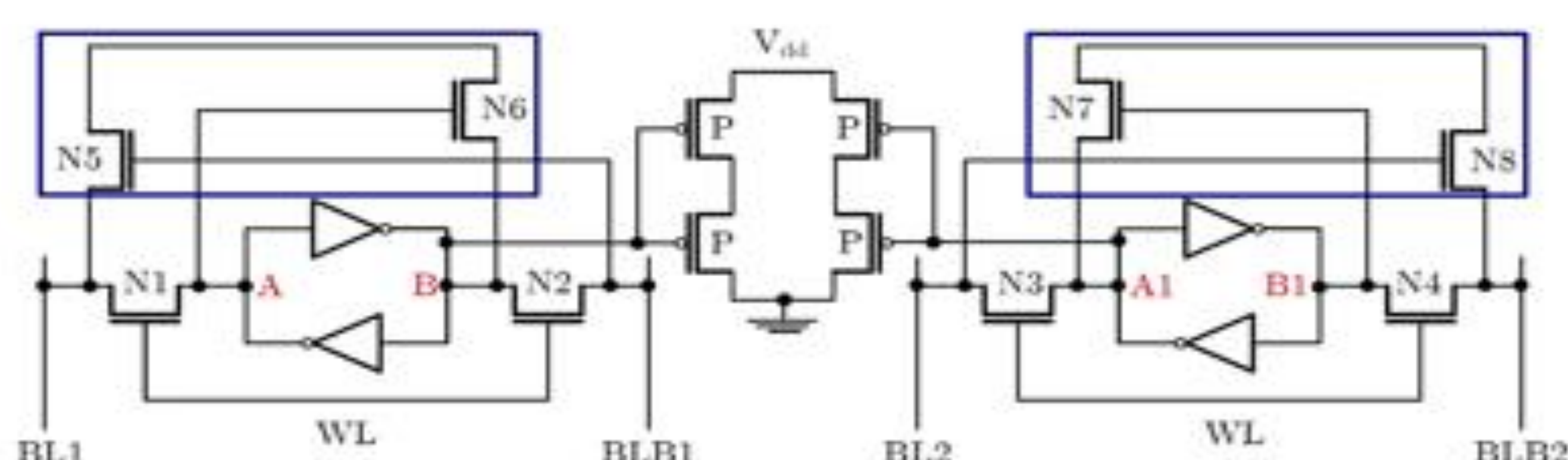
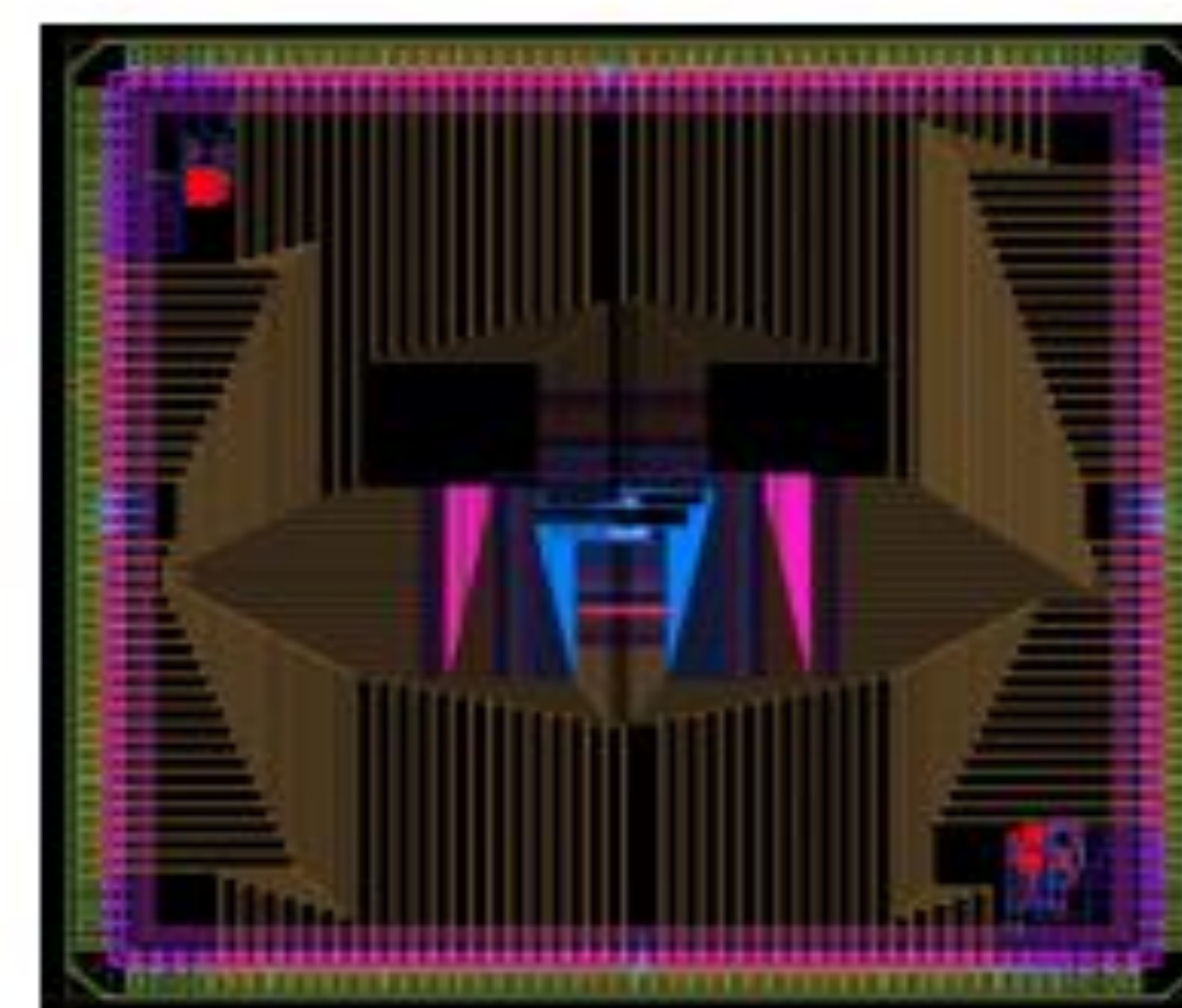


Fig 2: A Novel Ternary Content Addressable Memory

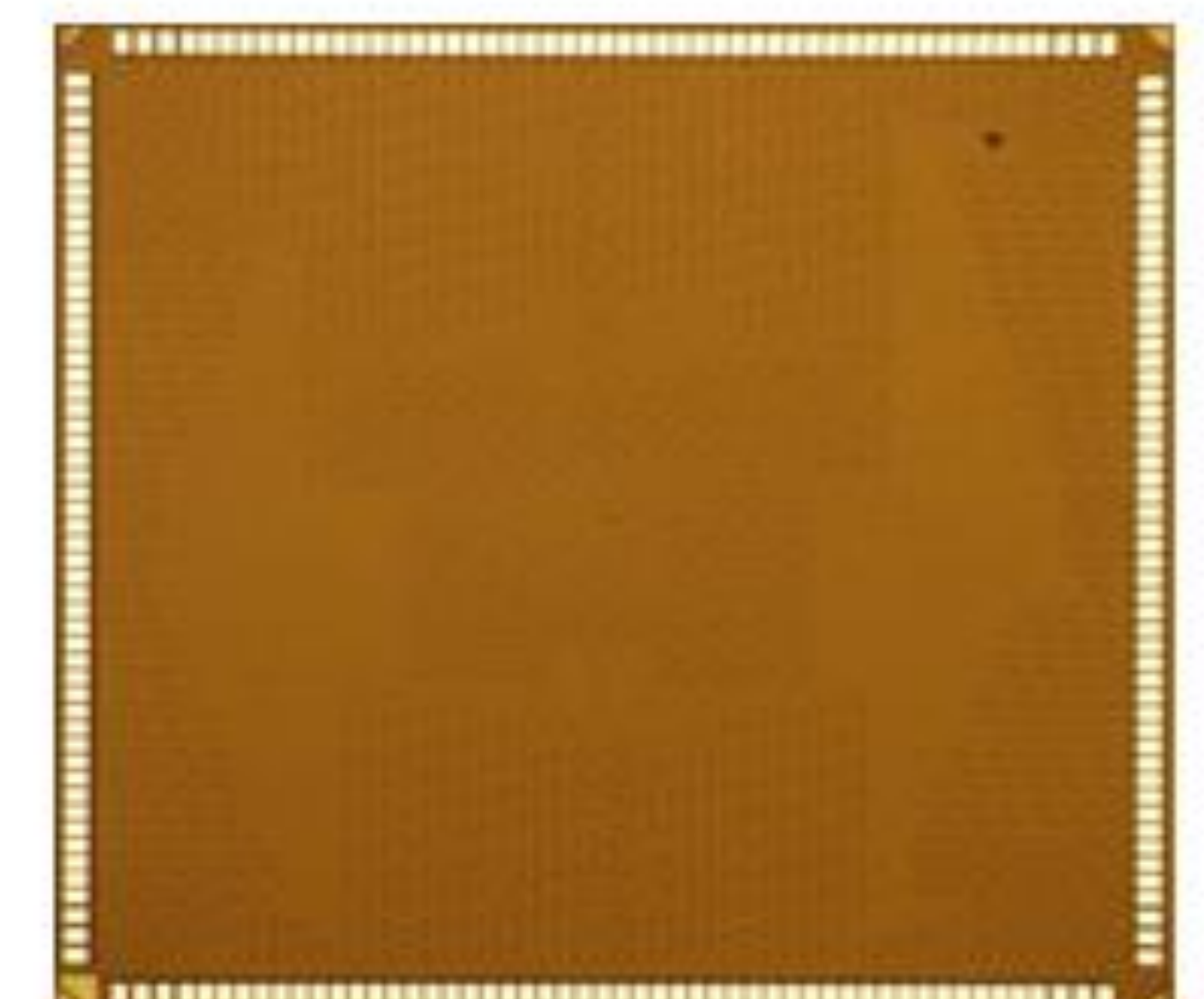
- The initial state of TCAM-PUF cell depends on process variations, it can be used as a weak PUF.
- In our design, when bits are initialized in power-up sequences, the node holding '1' is strengthened by the addition of two NMOS (N5, N6 and N7, N8) transistors to each of the SRAM cell in TCAM-PUF.
- Since internal node is strongly held in our design, our TCAM-PUF is robust to temperature and voltage variations.

CHIP IMPEMENTATION AND RESULTS

- The design is fabricated in 65nm Samsung process.
- Figure.3 represents the chip layout design and die micrograph.
- Fig.4 shows the results of reliability in different temperatures and voltages.
- Results in Fig.4 indicates that TCAM-PUF is more reliable than SRAM-PUF in various environmental conditions.



(a)



(b)

Fig 3: Samsung 65nm (a) Chip Layout (b) Die-Micrograph

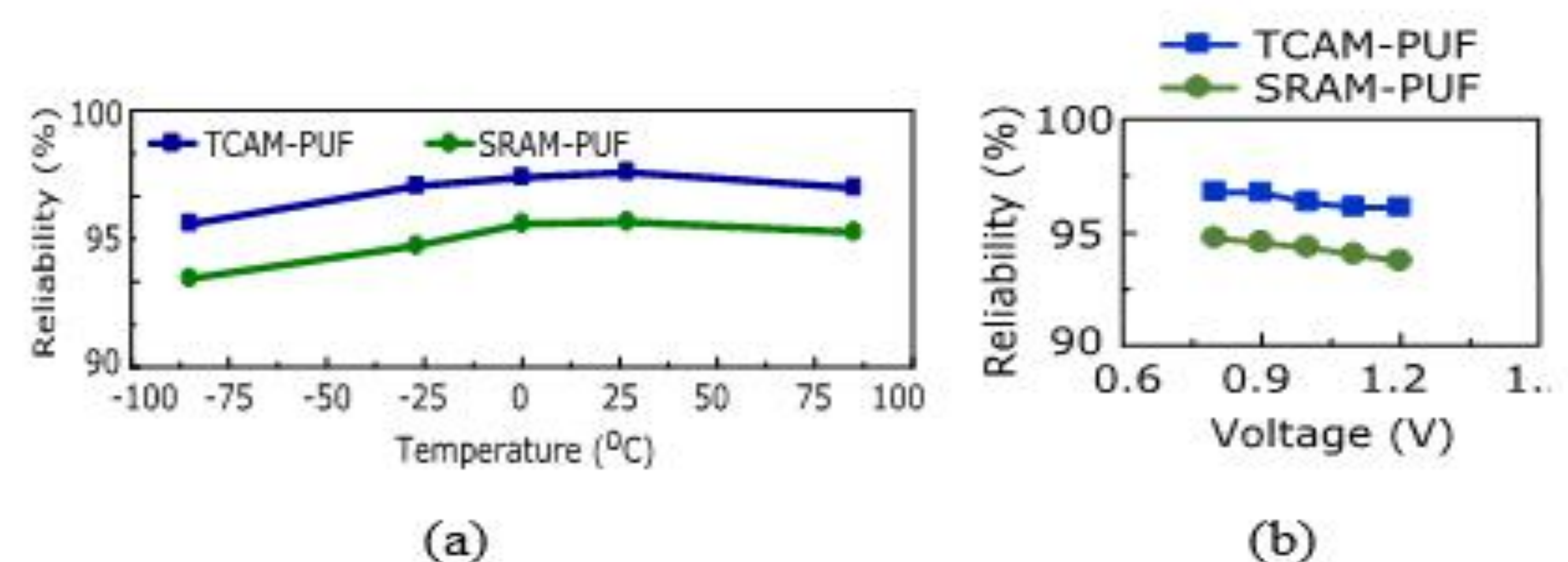


Fig 4: Reliability under different (a) temperature (b) voltage

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