

# 高信頼性、小セル面積、高スイッチング速度を目指した 16 Mb NRAM の開発

## Development of 16 Mb NRAM Aiming for High Reliability, Small Cell Area, and High Switching Speed

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アブストラクト: 55 nm CMOS の配線中に CNT(Carbon Nanotube)抵抗素子を組み込んだ(Fig.1)

16 Mb 1T1R NRAM(Carbon Nanotube Random-Access Memory)(Fig.2)を開発し、

150 °C リテンション試験で外挿での 100 kh (Fig.3)とエンデュランス試験で 1E6 サイクル(Fig.4)の優れた信頼性を示した。セルアレイのスイッチング速度は 200 ns である。さらに、

CNT 抵抗単体素子で、ヴィアピッチセル(Fig.5)により面積を 49 % 縮小し、ヴェリファイ動作無しで 0.5 ns の単一パルス高速スイッチング(Fig.6)を確認した。(Table 1)

### REFERENCES:

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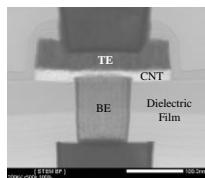


Fig. 1. Cross sectional TEM picture of CNT resistor element.

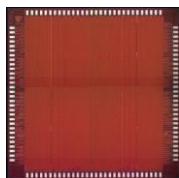


Fig. 2. Picture of 16 Mb 1T1R NRAM test die.

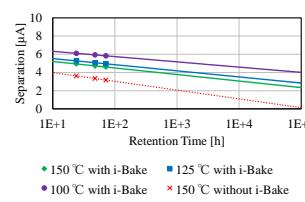


Fig. 3. Cell array retention.

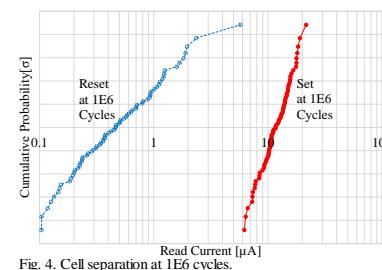


Fig. 4. Cell separation at 1E6 cycles.

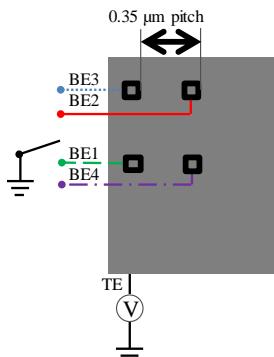


Fig. 5. The electrical test structure of common Top Electrode version A.

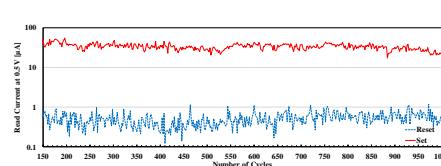


Fig. 6. 1E3 cycling at 0.5 ns single pulse write without verify.

CMOS Technology	55 nm
Memory Density of Test Die	16 Mb
Set Condition of Cell Array	2.5 V, 200 ns
Reset Condition of Cell Array	3.5 V, 100 ns
Read Voltage	0.5 V
Core Transistor Gate Length	0.15 μm
Extrapolated Retention	150 °C, 100 kh with i-Bake
Write Endurance	1E6 cycles
Switching Speed of CNT-RE	0.5 ns
Cell Size of 55 nm Technology	0.25 μm x 0.25 μm

Table 1. Summary of this work.