3D X-DRAM™

World’s First 3D NAND–like DRAM
2D DRAM

Not Scalable beyond 10 nm

- Capacitor
- Transistor
- Bit Line
- Contact
- Word Line
- Diffusion
3D DRAM

Transistor
Capacitor

Word Line
Channel
GOX
Dielectric
Bit Line

Complicated
Large Cell Size
Process Challenge
Low Yield
3D X-DRAM™ Cell Structure

Based on Capacitor-less Floating Body Cell Technology

- Floating Body
- Drain Region
- Source Line
- Gate Oxide
- Word Line
- Bit Line
3D X-DRAM™
Operations

Write 1 > Impact Ionization
Read 1 > On cell
3D X-DRAM™ Operations

No Hole

Write 0 > Forward Bias

Read 0 > Off cell

Channel off
3D X-DRAM™
Performance

Non-destructive Read

Dual-Gate Structure

Increase Data Retention Time
3D X-DRAM™
Array Structure

3D NAND-like Array

Vertical Bit Line
Word Line Layer
Source Line Layer
3D X-DRAM™

Process Steps

3D NAND-like Process

1. Deposit Multiple Layers
2. Deep Trench Bit Line Holes
3D X-DRAM™

Process Steps

3D NAND-like Process

1. Deposit Multiple Layers
2. Deep Trench Bit Line Holes
3. Plasma Doping for Floating Body
3D X-DRAM™

Process Steps

3D NAND-like Process

1. Deposit Multiple Layers
2. Deep Trench Bit Line Holes
3. Plasma Doping for Floating Body
4. Deposit Polysilicon Layer
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Process Steps

3D NAND-like Process
1 Deposit Multiple Layers
2 Deep Trench Bit Line Holes
3 Plasma Doping for Floating Body
4 Deposit Polysilicon Layer
5 Metal Fill Bit Line Hole
3D X-DRAM™

Process Steps

3D NAND-like Process

1. Deposit Multiple Layers
2. Deep Trench Bit Line Holes
3. Plasma Doping for Floating Body
4. Deposit Polysilicon Layer
5. Metal Fill Bit Line Hole
6. Wet Etch Nitride Layers
3D X-DRAM™
Process Steps

3D NAND-like Process
1. Deposit Multiple Layers
2. Deep Trench Bit Line Holes
3. Plasma Doping for Floating Body
4. Deposit Polysilicon Layer
5. Metal Fill Bit Line Hole
6. Wet Etch Nitride Layers
7. Deposit Gate Oxide Layer
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Process Steps

3D NAND-like Process
1 Deposit Multiple Layers
2 Deep Trench Bit Line Holes
3 Plasma Doping for Floating Body
4 Deposit Polysilicon Layer
5 Metal Fill Bit Line Hole
6 Wet Etch Nitride Layers
7 Deposit Gate Oxide Layer
8 Deposit Metal Word Lines
3D X-DRAM™
Process Advantages

1. Bit Line Mask
2. 8 Key Steps
   - Self-Aligned
3D NAND

3D X-DRAM

Similar Processes
3D X-DRAM™
Memory Density

230 Layers

128 Gb

8X Density

Estimated Density
The Future
DRAM Technology

- 4Gb
- 8Gb
- 16Gb
- 256Gb
- 512Gb
- 1Tb

3D X-DRAM

2D DRAM

Estimated Roadmap
More Memory for AI Chip

High Bandwidth Memory (HBM)

3D X-DRAM
1.5 TB

2D DRAM
192 GB

Estimated Capacity
AI Revolution

Remote
Memory Computing

Local
Memory Computing
Thank You