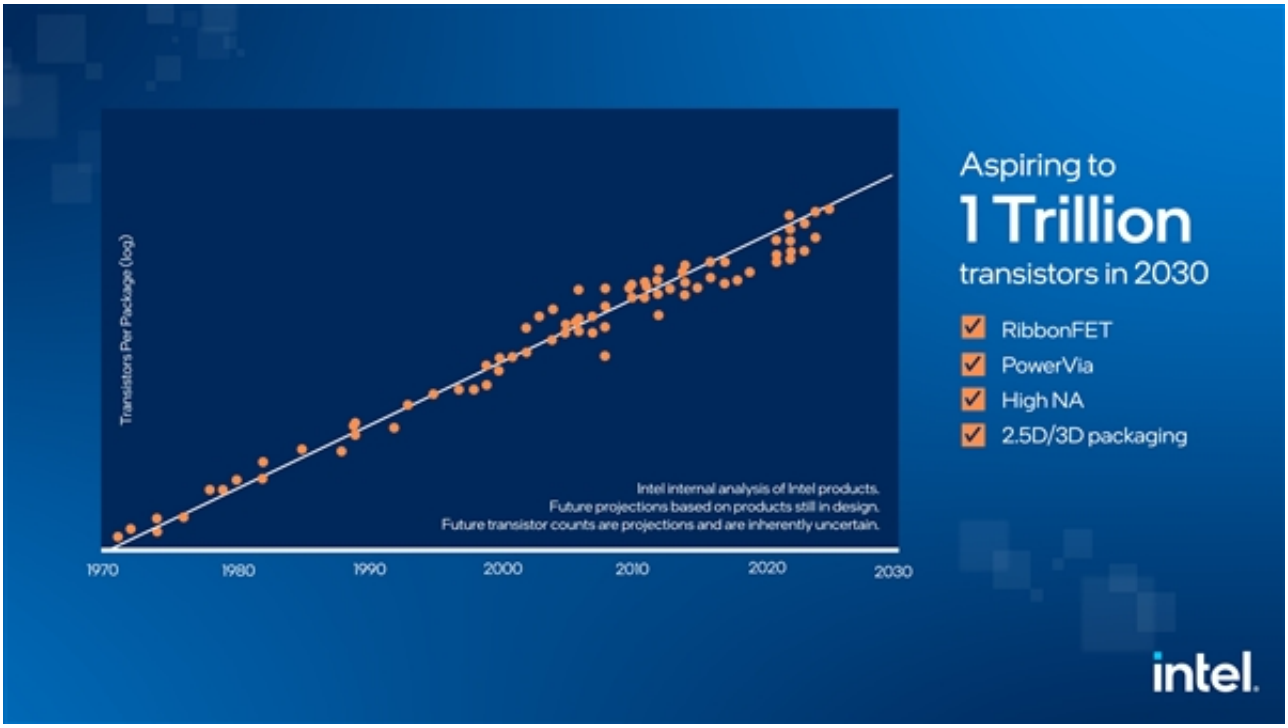
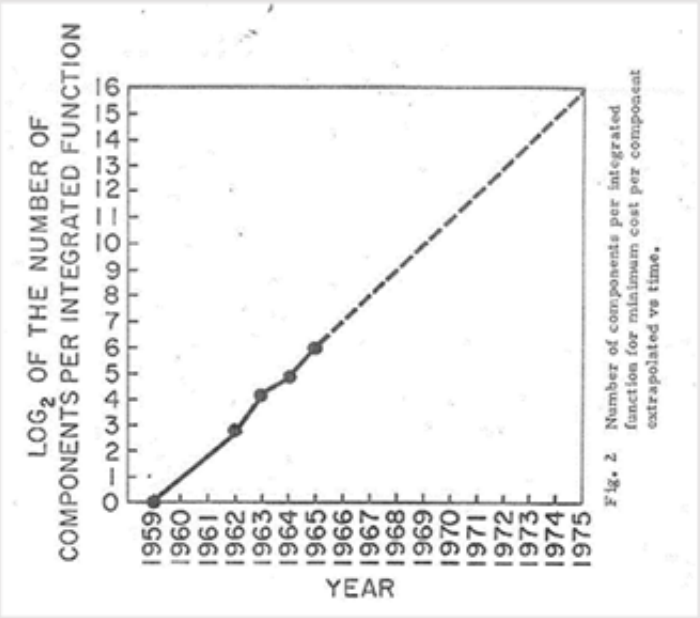
Intel目标2030年做到单芯片集成1万亿个晶体管

晶体管的数量/密度一直是衡量半导体技术进步的重要指标。目前单个芯片上可以实现超过1000亿个晶体管，比如Intel Ponte Vecchio GPU。在IEDM 2022 IEEE国际电子设备大会上，英特尔宣布了多项新的技术突破，并将继续执行已经诞生75年的摩尔定律。目标是到2030年在单个芯片上集成1万亿个晶体管，是现在的10倍。

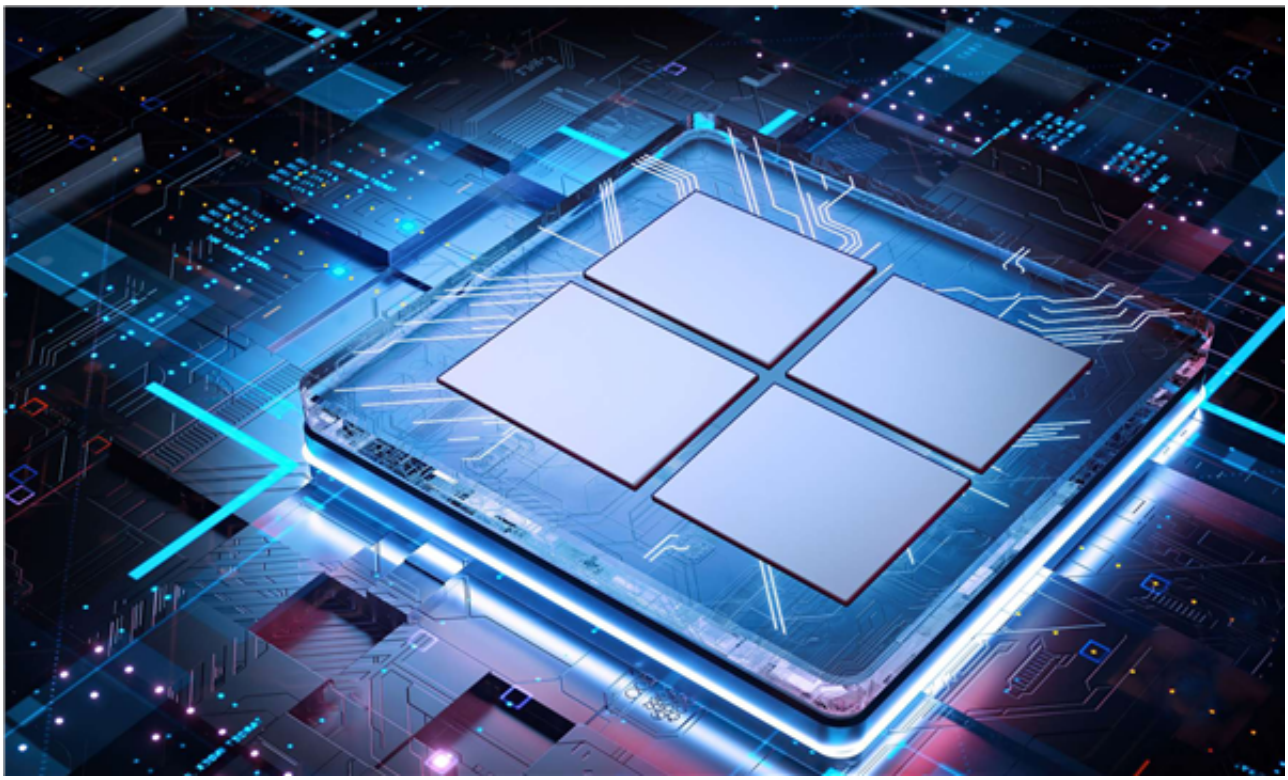




摩尔定律原型

从应变硅、高K金属栅极、FinFET立体晶体管，到未来的RibbonFET GAA环绕栅极晶体管、PowerVia后置供电，再到2.5D EMIB＋3D Foveros、Foveros Direct/Omni封装技术，Intel一直在从各项技术上推动摩尔定律。

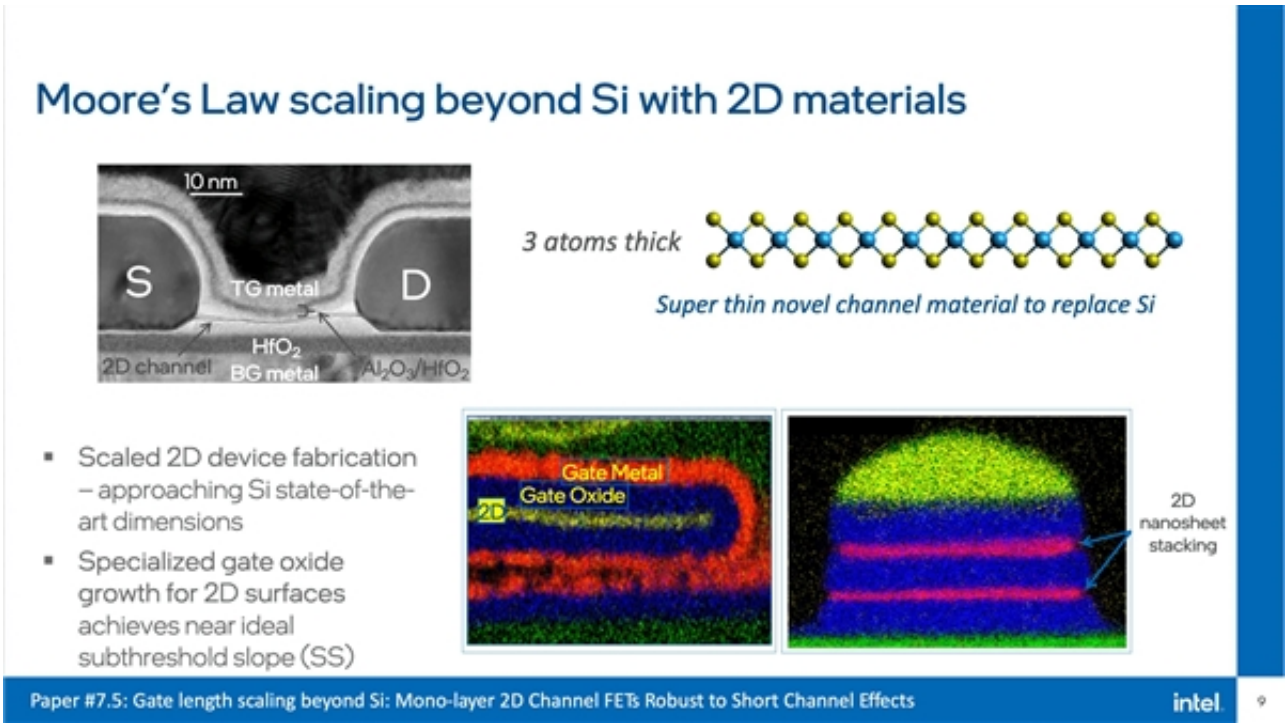
IEDM 2022会议上，Intel披露了三个方面的技术突破：



1、下一代3D封装准单芯片

基于混合键合(hybrid bonding)，将集成密度和性能再提升10倍。

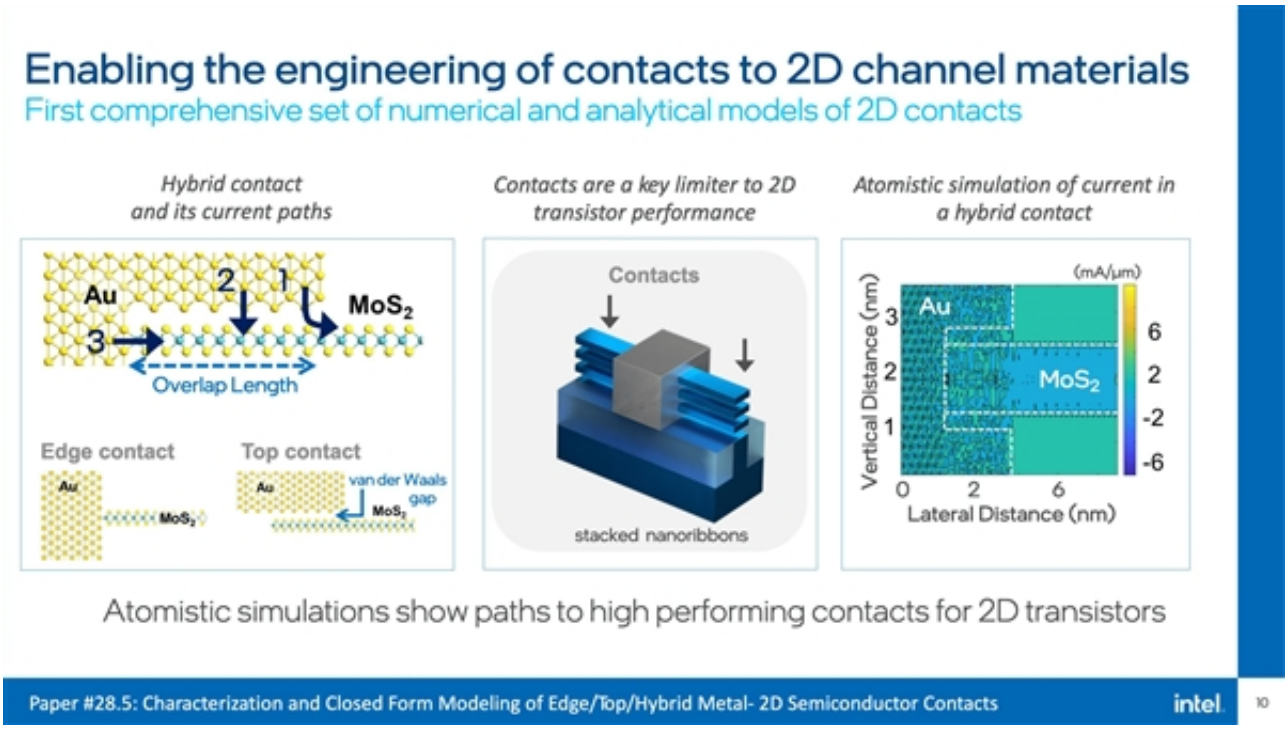
同时，间距缩小到3微米，使得多芯片互连密度和带宽媲美如今的单芯片SoC。



2、超薄2D材料在单芯片内集成更多晶体管

使用厚度仅仅3个原子的2D通道材料，Intel展示了GAA堆栈纳米片，在双栅极结构上，在室温环境、低漏电率下，达成了非常理想的晶体管开关速度。

第一次深入揭示了2D材料的电接触拓扑，可实现更高性能、更有弹性的晶体管通道。



3、高性能计算能效、内存新突破

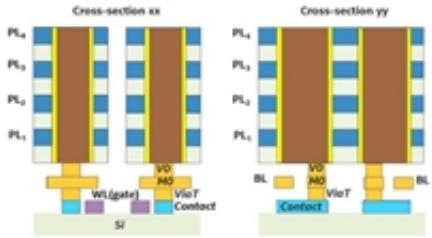
Intel研发了可垂直堆叠在晶体管之上的全新内存，并首次展示了全新的堆叠铁电电容，性能媲美传统铁电沟道电容，可用于在逻辑芯片上打造FeRAM。

Intel正在打造300毫米直径的硅上氮化镓晶圆，比标准的氮化镓提升20倍。

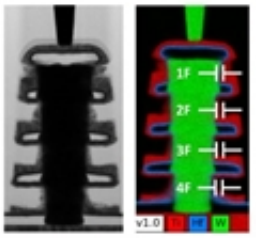
Intel在超高能效方面也取得了新的突破，尤其是晶体管在断电后也能保存数据，三道障碍已经突破两道，很快就能达成在室温下可靠运行。

First demonstration of 3D stacked capacitors for FeRAM density

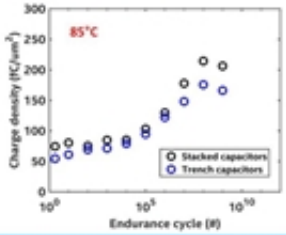
- At IEDM 2020, Intel presented 3D FeRAM concept
- Breakthrough in 1T-1C FeRAM scaling by stacking (Anti)-ferroelectric capacitors.
- Research for the future of embedded memory



IEDM 2022 marks industry's first demonstration of stacked array capacitors with matched performance to conventional ferroelectric trench capacitors.



- Stack deposition
- Capacitor via etch
- Capacitor via fill and polish
- Dielectric cap deposition
- Sacrificial material exposure etch
- Isotropic sacrificial material removal
- ALD HfZrO deposition
- ALD TiN top electrode deposition
- Top electrode isolation
- ILD fill and planarization
- Contact patterning and etch
- TiN/W metallization



Paper #6.7: Hafnia-Based FeRAM: A Path Toward Ultra-High Density for Next-Generation High-Speed Embedded Memory

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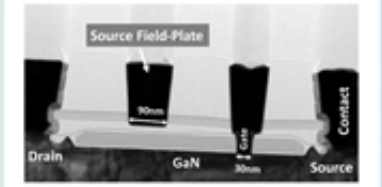
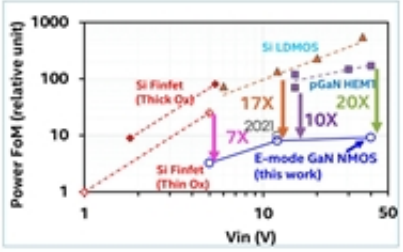
Major advancement in 300mm GaN-on-Si technology

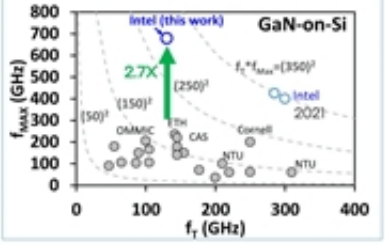
Enabling silicon to keep pace with power and performance demands

Industry record Figure-of-Merit for power switches and RF transistors



E-mode high-K GaN Transistor (Source Field-Plate)





- 20x gain (resistance times charge) over industry standard GaN
  - Industry best Figure-of-Merit for high-performance power delivery
- Record cut-off frequency, f_{MAX} of 680GHz for 5G and beyond
- Viable path to 300mm GaN-on-silicon wafers

Paper #35.1: Scaled Submicron Field-Plated Enhancement Mode High-K Gallium Nitride Transistors on 300mm Si(111) Wafer with Power FoM (RONxQGG) of 3 mohm-nC at 40V and fT/fMAX of 130/680GHz

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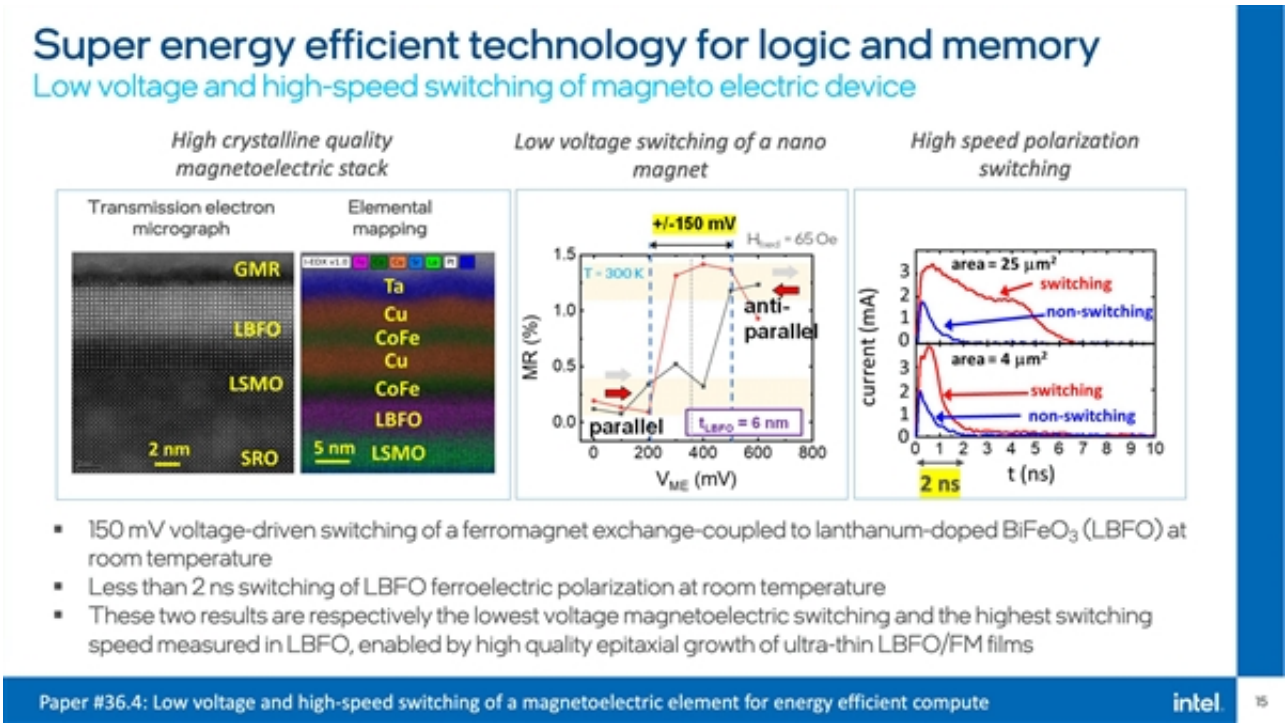

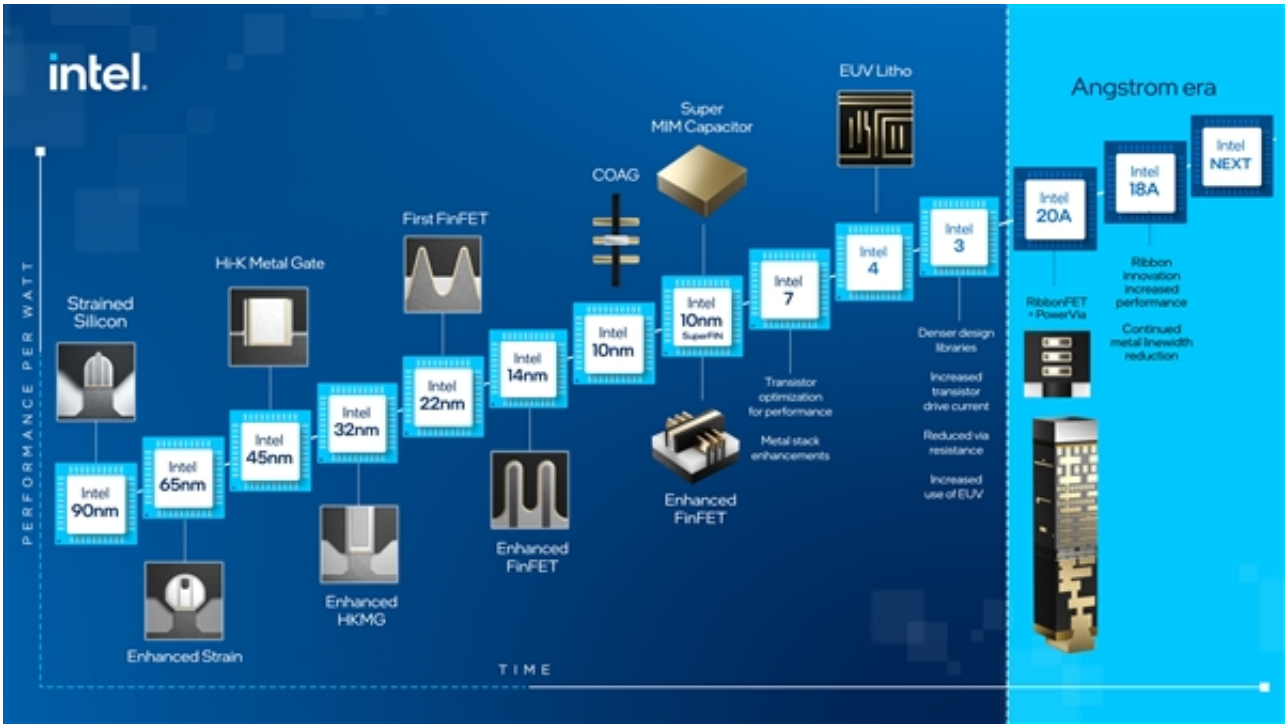

Intel制造工艺路线图

本文链接：https://dqcm.net/zixun/16701787041456.html