

FinFET Transistors:

Life on the Edge with vertical CMOS channels

Date: Oct 14, 2014

Place: Evans Analytical Group, 810 Kifer Road, Sunnyvale, CA 94086

1-1:40 pm **Witek Maszara**/ Global Foundries

The long and winding road to finFETs: a bit of past, present and future.

1:40-2:15 pm **John Borland**/ J.O.B Technologies

FinFET doping at 22nm, 14/16nm and 10nm nodes.

2:15-2:45 pm **Susan Felch**/ Susan Felch Consulting

Doping FinFETs: Tradeoffs for Beamline Implantation, Plasma Doping, and Diffusion from Doped Epi/CVD Films.

2:45-3 pm Cookie break and discussions

3-3:30 pm **Sunnie Wang**/ Applied Materials

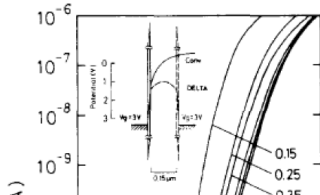
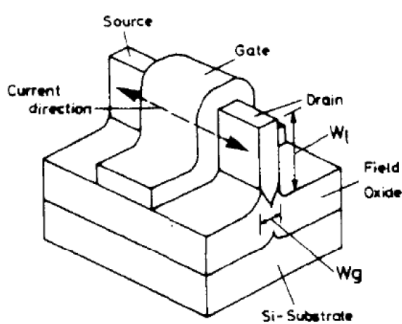
Plasma Doping (PLAD) Approaches for 3D FinFET Extensions.

3:30-4 pm **Michael Current**/ Current Scientific

A discussion of "damage engineering" in vertical fin arrays.

FinFETs: A long time coming

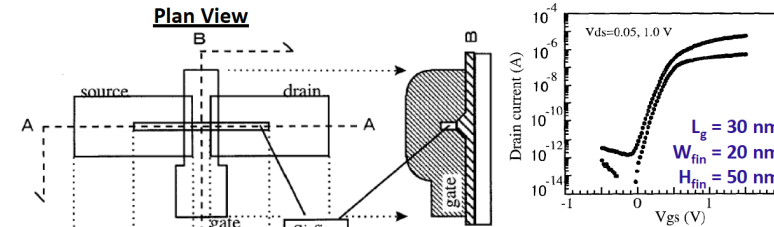
D. Hisamoto, T. Kaga, Y. Kawamoto, and E. Takeda (Hitachi Central Research Laboratory),
 "A fully depleted lean-channel transistor (DELTA) – a novel vertical ultrathin SOI MOSFET,"
 IEEE Electron Device Letters Vol. 11, pp. 36-39, 1990



1990: Hitachi CRL

D. Hisamoto, W.-C. Lee, J. Kedzierski, E. Anderson, H. Takeuchi, K. Asano, T.-J. King, J. Bokor, and C. Hu,
 "A folded-channel MOSFET for deep-sub-tenth micron era,"
 IEEE International Electron Devices Meeting Technical Digest, pp. 1032-1034, 1998

- Improved gate control observed for $W_g < 0.3 \mu\text{m}$
 - $L_{\text{EFF}} = 0.57 \mu\text{m}$



X. Huang, W.-C. Lee, C. Kuo, D. Hisamoto, L. Chang, J. Kedzierski, E. Anderson, H. Takeuchi, Y.-K. Choi, K. Asano, V. Subramanian, T.-J. King, J. Bokor, and C. Hu, "Sub 50-nm FinFET: PMOS,"
 IEEE International Electron Devices Meeting Technical Digest, pp. 67-70, 1999

1998: UCB

- Devices with L_g down to 17 nm were successfully fabricated

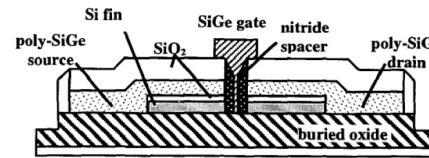
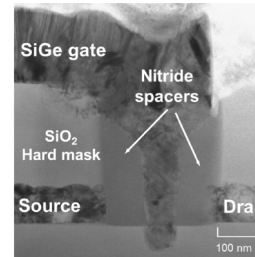
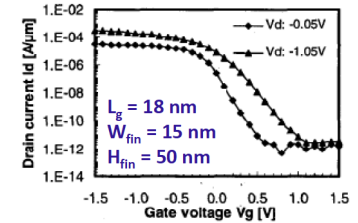
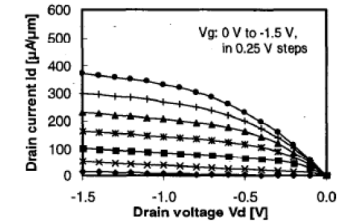


Figure 1: Schematic drawing of FinFET



Transmission Electron Micrograph

1999: UCB



FinFets....a Million Year History



2001 Space Odyssey
Kubrick68

A Modern Monolith Sighting



Multi-Gate Array in Stone

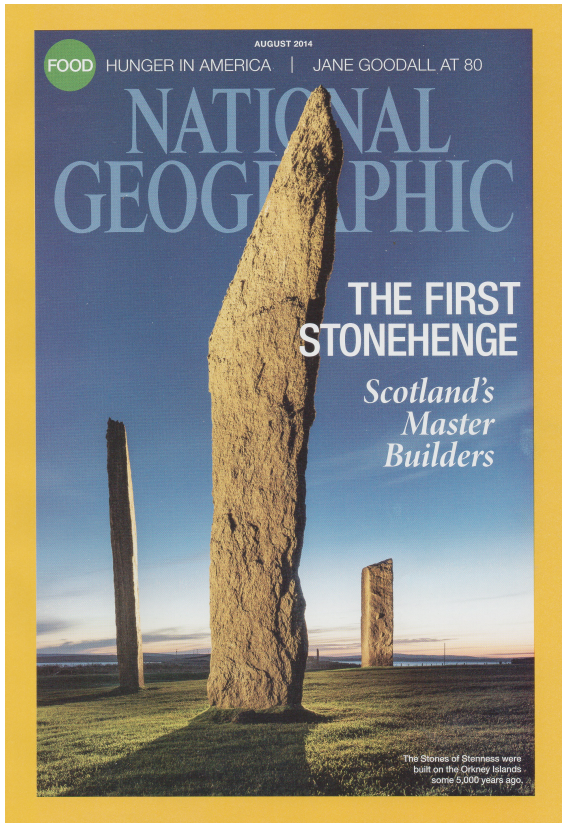
(Stonehenge: 3,000-2,000 BC)



Stonehenge, UK

Okney Island, Scotland Stone Arrays

≈3,100 BC



Stones of Stenness



Ring of Brodgar

National Geographic
August, 2014

FinFETs...an 11,500 year history



Gobekli Tepe, Turkey
Multi-orientation fin array, 9.5k BC



Smithsonian, Nov08

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