

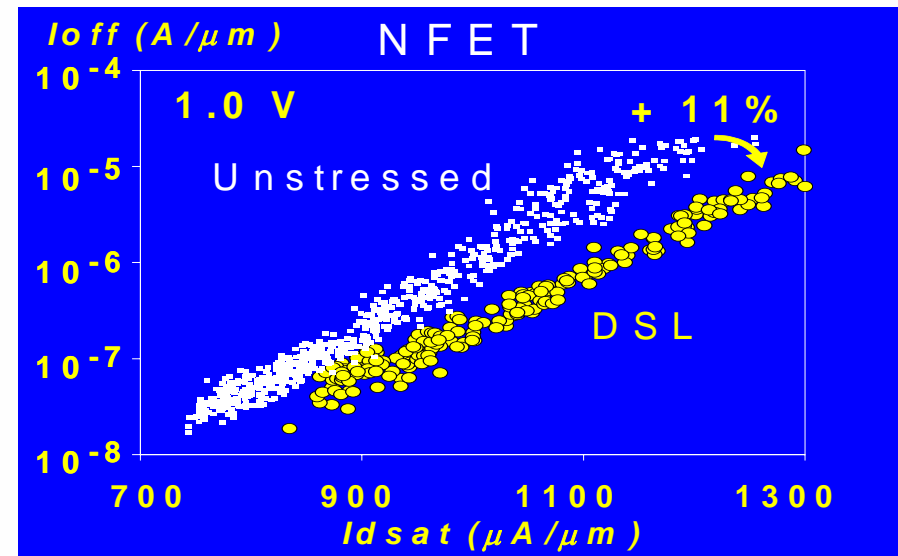
# **Compact Model Methodology for Dual-Stress Nitride Liner Films in a 90nm SOI Technology**

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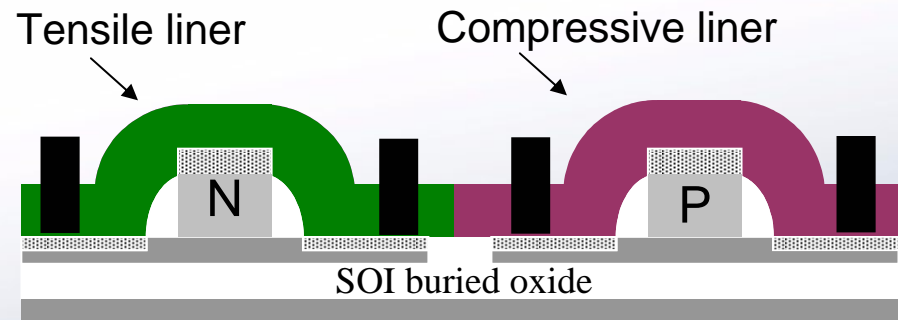
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# Introduction

- Significant baseline performance improvement from nitride liner films with intentional stress
- Reformulated etch stop/contamination barrier
- Dual-stress liner technologies employ both tensile and compressive films
- Local stress variations are possible due to structures at the same level as the liner films.
  - Local interconnect/poly
  - Stress film interface



Yang et al, IEDM 2004



# Model methodology overview

- **Complex 2D/3D stress field modeled as 1D longitudinal and transverse stress levels**
- **1D stress levels calculated from layout information**
  - **Tight coupling between netlist extraction and the compact model**
- **1D stress levels converted into a relative scale factor on mobility**
- **Apply mobility scale factor to compact model calibrated to a reference layout (baseline stress response)**
- **Built on top of BSIMSOI**

# Stress model formulation

- **Composite stress terms**

$$\sigma^L = \sigma_{self} - \sigma_{contacts} - \sigma_{poly} - \sigma_{DSL}^L \qquad \sigma^T = \sigma_{DSL}^T + \sigma_{body\ contact}$$

- **Stress term response generally goes as 1/distance**
- **Stress-to-mobility map (elastic linear response)**

$$u_0 = u_0 (c_1^{long} \sigma^L + c_0^{long} + c_1^{trans} \sigma^T + c_0^{trans} )$$

# Model-to-hardware comparison

- **Comparison shows**
  - Data
  - Stress model
  - Fixed stress model
- **Model captures the trends of localized layout variation across different layout styles**

