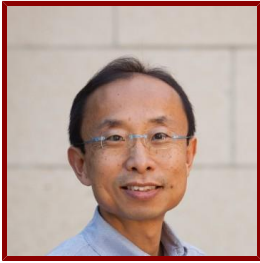


# Stanford

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## H.-S. Philip Wong

Willard R. and Inez Kerr Bell Professor in the School of Engineering  
Electrical Engineering

### CONTACT INFORMATION

- **Alternate Contact**

Fely Barrera - Administrative Contact

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### Bio

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#### BIO

Wong joined Stanford in 2004 after 16 years at IBM Research, with appointments as research staff member, Manager, and Senior Manager. While at IBM, he was responsible for shaping and executing IBM's strategy on nanoscale science and technology and silicon technology. His interests are in the area of nanoscale science and technology, semiconductor technology, solid-state devices, and electronic imaging.

His present research covers a broad range of topics including carbon electronics, 2D layered materials, wireless implantable biosensors, directed self-assembly, nanoelectromechanical relays, device modeling, brain-inspired computing, and non-volatile memory devices such as phase change memory and metal oxide resistance change memory.

#### ACADEMIC APPOINTMENTS

- Professor, Electrical Engineering
- Member, Bio-X
- Affiliate, Precourt Institute for Energy
- Member, Wu Tsai Neurosciences Institute

#### HONORS AND AWARDS

- Fellow, IEEE (2001)

#### PROGRAM AFFILIATIONS

- Stanford SystemX Alliance

#### PROFESSIONAL EDUCATION

- PhD, Lehigh (1988)

#### LINKS

- <http://nano.stanford.edu>: <http://nano.stanford.edu>

- <http://www.stanford.edu/~hspwong>: <http://www.stanford.edu/~hspwong>

## Teaching

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### COURSES

#### 2017-18

- Advanced VLSI Devices: EE 316 (Win)
- Semiconductor Memory Devices and Technology: EE 309 (Aut)
- What is Nanotechnology?: EE 21N (Win)

#### 2016-17

- Advanced VLSI Devices: EE 316 (Win)
- Nanoelectronics: EE 320 (Spr)
- What is Nanotechnology?: EE 21N (Win)

#### 2015-16

- What is Nanotechnology?: EE 21N (Win)

### STANFORD ADVISEES

#### Doctoral Dissertation Reader (AC)

Elyse Barre, Victoria Chen

#### Postdoctoral Faculty Sponsor

Raisul Islam

#### Doctoral Dissertation Advisor (AC)

Haitong Li, Rebecca Park

#### Doctoral (Program)

Haitong Li, Rebecca Park

## Publications

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### PUBLICATIONS

- **Compound Semiconductor Devices Lateral Scale Down of InGaAs/InAs Composite-Channel HEMTs With Tungsten-Based Tiered Ohmic Structure for 2-S/mm gm and 500-GHz fT..... H. Matsuzaki, T. Maruyama, T. Koasugi, H. Takahashi, M. Tokumitsu, and T. Enoki 378 SThM Temperature Mapping and Nonlinear Thermal Resistance Evolution With Bias on AlGaIn/GaN HEMT Devices**  
Aubry, R., Jacquet, J. C., Weaver, J., Durand, O., Dobson, P., Mills, G., Wong, H.S.Philip
- **SPECIAL ISSUE ON NANOMETER-SCALE SCIENCE AND TECHNOLOGY**  
Chen, W., Frank, D. J., Ismail, K. E., Lo, S., Sai-Halasz, G., Viswanathan, R. G.
- **Design and Benchmarking of BCPMOS Versus SCPMOS for an Evolutionary 0.25- $\mu$ m CMOS Technology..... H.-H. Vuong, SA Eshraghi, CS Rafferty, SJ Hillenius, MR Pinto, PW Diodato, H.-I. Cong, and PM Zeitzoff 991 An Analytical Model for the Electron Velocity Overshoot Effects in Strained-Si on Si Ge MOSFET's..... JB Roldán, F. Gámiz, JA López-Villanueva, and JE Carceller 993**  
Rodríguez, R., Nafra, M., Suné, J., Aymerich, X., Wong, H., Chang, R. T.
- **Technical Program Committee Members**  
Akkipedi, I. R., Arakawa, Y., Arai, F., Bhattacharya, P., Chau, R., Chen, J., Wong, H.S.Philip
- **Reliability of Graphene Interconnects and N-type Doping of Carbon Nanotube transistors**  
Liyange, L. S., Chen, X., Wei, H., Chen, H., Mitra, S., Wong, H. S.

- **26.3 Investigation of Performance Limits of III-V Double-Gate n-MOSFETs** *INTERNATIONAL ELECTRON DEVICES MEETING*  
Pethe, A., Krishnamohan, T., Kim, D., Oh, S., Wong, H., Nishi, Y.  
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- **AUSTIN MINNICH**  
Schmidt, A., Bahk, J. H., Favaloro, T., Shakouri, A., Shen, S., Dames, C., Wong, H.S.Philip
- **Carbon Nanotube Transistor Compact Model**  
Deng, J., Wan, G. C., Wong, H. S.
- **IEDM Executive Committee**  
Candelaria, J., Mistry, K., Wong, H. S., Jeong, M., Brederlow, R., Auth, C.
- **Nurse Support Program II**  
Puddester, F. W., Sexton, K. J., Antos, J. R., Bone, G., Lowthers, C., Wong, H. S.
- **The two VLSI-TSA plenary talks feature the following keynote speeches:" Has The Sun Finally Risen on Photovoltaics?" by Dr. Mark Pinto from Applied Materials, USA and" Carrier Transport and Stress Engineering in Advanced Nanoscale MOS Transistors" by Dr. Ken Uchida from Tokyo Institute of Technology, Japan. Two special emerging technology sessions feature the progress of Green Devices and Next**  
Wong, H. S.
- **CONVERGENCE PLATFORMS: FOUNDATIONAL SCIENCE AND TECHNOLOGY TOOLS**  
Lundstrom, M., Wong, H. S.
- **Sponsored by the IEEE Electron Devices Society IEEE**  
Bryant, A., Guo, J., Kalavade, P., Loo, L., O'Brien, J., Wong, H. S.
- **14: 40 B-1-3 Electrical Stress Effects on Mobility of Germanium-On-Insulator (GeOI) pMOSFETs with HfO<sub>2</sub> Gate Dielectric** *SOLID STATE DEVICES AND MATERIALS*  
Yi, J. H., Oh, S., Wong, H. S.  
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- **A Fully Analytical Model for Carbon Nanotube FETs including Quantum Capacitances and Electrostatics**  
Wei, L., Frank, D. J., Chang, L., Wong, H.
- **Compound Semiconductor Devices Analysis of DC–RF Dispersion in AlGaIn/GaN HFETs Using RF Waveform Engineering..... C. Roff, J. Benedikt, PJ Tasker, DJ Wallis, KP Hilton, JO Maclean, DG Hayes, MJ Uren, and T. Martin 13 Molecular and Organic Devices A Charge-Based OTFT Model for Circuit Simulation..... F. Torricelli, ZM Kovács-Vajna, and L. Colalongo 20**  
Lin, D. A., Kumar, R. S., Cheng, L. S., Jin, C., Vaidya, V., Kim, J., Wong, H.S.Philip
- **Challenges in Colloidal Phase Change Nanoparticle Devices**  
Caldwell, M. A., Milliron, D. J., Wong, H. S.
- **LATERALLY ACTUATED NANOELECTROMECHANICAL RELAYS WITH COMPLIANT, LOW RESISTANCE CONTACT**  
Shavezipur, M., Lee, W. S., Harrison, K. L., Provine, J., Mitra, S., Wong, H. S.
- **BEST PAPER CANDIDATES**  
Eggersgluß, S., Wille, R., Drechsler, R., Zhang, Y., Luk, W., Yan, C., Wong, H.S.Philip
- **Solid-State Power and High Voltage A Highly Efficient 1.9-GHz Si High-Power MOS Amplifier..... I. Yoshida, M. Katsueda, Y. Maruyama, and I. Kohjiro 953 A MOS-Controlled High-Voltage Thyristor with Low Switching Losses..... W. Hermansson, B. Breitholtz, LCG Zdansky, K. Andersson, LF Heijkenskjöld, R. Revsäter, and D. Sigurd 957 Vacuum Electron Devices**  
Rodríguez, R., Nafría, M., Suné, J., Aymerich, X., Wong, H., Chang, R. T.
- **Carbon Nanotube Vacuum Gauges With Wide Dynamic Range..... AB Kaul and HM Manohara 252 On the Probabilistic Characterization of Nano-Based Circuits..... X. Lu, J. Li, and W. Zhang 258 Novel Local Silicon-Gate Carbon Nanotube Transistors Combining Silicon-on-Insulator Technology for Integration..... M. Zhang, PCH Chan, Y. Chai, Q. Liang, and ZK Tang 260 Formation and Optical Characteristics of Type-II Strain-Relieved GaSb/GaAs Quantum Dots by Using an Interfacial Misfit**  
Amlani, I., Lee, K. F., Deng, J., Wong, H., Paydavosi, N., Holland, K. D.

- **IEDM Executive Committee**  
Wong, H. S., Brederlow, R., Ishimaru, K., Auth, C., Misra, V., Subramanian, V.
- **Nanoelectronic Devices 11**  
Wong, H. S.
- **Imperfection-Immune Carbon Nanotube VLSI**  
Deng, J., Lin, A., Patil, N., Wan, G., Wei, H., Wong, H. S.
- **Physics of electrical conduction in the sub-threshold regime and crystallization due to thermal disturbances in phase-change memory**  
Ahn, C., Lee, B., Jeyasingh, R. G., Asheghi, M., Goodson, K., Wong, H. S.
- **Thermal Phenomena in Phase Change Memory Devices**  
Goodson, K. E., Asheghi, M., Wong, H. S.
- **A 0.5  $\mu\text{m}$  Pixel Frame-Transfer CCD Image Sensor in 110nm CMOS**  
Fife, K., Gamal, A. E., Wong, H. S.
- **Contact Properties of Titanium Nitride Sidewall Coating for Nanoelectromechanical Electronics**  
Shavezipur, M., Harrison, K. L., Lee, W. S., Espinosa, B., Provine, J., Mitra, S., Wong, H.S.Philip
- **Methodologies to Study the Scalability and Physics of Phase Change Memory devices** *Cell 1, 5 $\mu\text{m}$*   
Jeyasingh, R. G., Caldwell, M. A., Liang, J., Ahn, C., Wong, H.
- **Session 2E: Compound Semiconductors**  
Kim, S. B., Lee, B., Asheghi, M., Hurkx, G., Reifenberg, J., Goodson, K., Wong, H.S.Philip
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Hills, G., Zhang, J., Shulaker, M. M., Wei, H., Lee, C., Balasingam, A., Wong, H. P., Mitra, S.  
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- **Large-Area Assembly of Densely Aligned Single-Walled Carbon Nanotubes Using Solution Shearing and Their Application to Field-Effect Transistors** *ADVANCED MATERIALS*  
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- **Continuous wireless pressure monitoring and mapping with ultra-small passive sensors for health monitoring and critical care** *NATURE COMMUNICATIONS*  
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- **Carbon nanotubes for high-performance logic** *MRS BULLETIN*  
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- **Improved Performance of Bottom-Contact Organic Thin-Film Transistor Using Al Doped HfO<sub>2</sub> Gate Dielectric** *IEEE TRANSACTIONS ON ELECTRON DEVICES*  
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- **Ultrafast terahertz-induced response of GeSbTe phase-change materials** *APPLIED PHYSICS LETTERS*  
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2014; 104 (25)
- **Ultrafast characterization of phase-change material crystallization properties in the melt-quenched amorphous phase.** *Nano letters*  
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2014; 14 (6): 3419-3426
- **Multi-level control of conductive nano-filament evolution in HfO<sub>2</sub> ReRAM by pulse-train operations** *NANOSCALE*  
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Tian, H., Chen, H., Ren, T., Li, C., Xue, Q., Mohammad, M. A., Wu, C., Yang, Y., Wong, H. P.  
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- **Computer-Aided Diagnosis of Hyperacute Stroke with Thrombolysis Decision Support Using a Contralateral Comparative Method of CT Image Analysis** *JOURNAL OF DIGITAL IMAGING*  
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2014; 27 (3): 392-406
- **3-D Cross-Point Array Operation on AlO<sub>y</sub>/HfO<sub>x</sub>-Based Vertical Resistive Switching Memory** *IEEE TRANSACTIONS ON ELECTRON DEVICES*  
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2014; 61 (5): 1377-1381
- **System Level Benchmarking with Yield-Enhanced Standard Cell Library for Carbon Nanotube VLSI Circuits** *ACM JOURNAL ON EMERGING TECHNOLOGIES IN COMPUTING SYSTEMS*  
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- **VLSI-Compatible Carbon Nanotube Doping Technique with Low Work-Function Metal Oxides.** *Nano letters*  
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- **Sensor-to-Digital Interface Built Entirely With Carbon Nanotube FETs**  
Shulaker, M. M., Rethy, J. V., Hills, G., Wei, H., Chen, H. Y., Gielen, G., Wong, H.S.Philip  
2014
- **Statistical Assessment Methodology for the Design and Optimization of Cross-Point RRAM Arrays** *IEEE 6th International Memory Workshop (IMW)*  
Li, H., Jiang, Z., Huang, P., Chen, H., Chen, B., Liu, R., Chen, Z., Zhang, F., Liu, L., Gao, B., Liu, X., Yu, S., Wong, et al  
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- **Electrochemical Metallization and Trapping/De trapping Resistive Switching Mechanism in Al/VO<sub>x</sub>/Cu RRAM** *ECS SOLID STATE LETTERS*  
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- **Directed Self-Assembly (DSA) Template Pattern Verification** *51st ACM/EDAC/IEEE Design Automation Conference (DAC)*  
Xiao, Z., Du, Y., Tian, H., Wong, M. D., Yi, H., Wong, H. P., Zhang, H.  
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- **DSA Template Optimization for Contact Layer in 1D Standard Cell Design** *Conference on Alternative Lithographic Technologies VI*  
Xiao, Z., Du, Y., Tian, H., Wong, M. D., Yi, H., Wong, H. P.  
SPIE-INT SOC OPTICAL ENGINEERING.2014
- **Write Disturb Analyses on Half-Selected Cells of Cross-Point RRAM Arrays** *International Reliability Physics Symposium (IRPS)*  
Li, H., Chen, H., Chen, Z., Chen, B., Liu, R., Qiu, G., Huang, P., Zhang, F., Jiang, Z., Gao, B., Liu, L., Liu, X., Yu, et al  
IEEE.2014
- **Optimization and Mechanism on Chemical Mechanical Planarization of Hafnium Oxide for RRAM Devices** *ECS JOURNAL OF SOLID STATE SCIENCE AND TECHNOLOGY*  
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- **Oral and topical boswellic acid attenuates mouse osteoarthritis** *OSTEOARTHRITIS AND CARTILAGE*  
Wang, Q., Pan, X., Wong, H. H., Wagner, C. A., Lahey, L. J., Robinson, W. H., Sokolove, J.  
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- **Brain-like associative learning using a nanoscale non-volatile phase change synaptic device array.** *Frontiers in neuroscience*  
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Shulaker, M. M., Van Rethy, J., Hills, G., Wei, H., Chen, H., Gielen, G., Wong, H. P., Mitra, S.  
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- **System Level Benchmarking with Yield-Enhanced Standard Cell Library for Carbon Nanotube VLSI Circuits** *ACM Journal on Emerging Technologies in Computing Systems*  
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- **Synaptic electronics: materials, devices and applications** *NANOTECHNOLOGY*  
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- **Mass fabrication and delivery of 3D multilayer mu Tags into living cells** *SCIENTIFIC REPORTS*

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  - **Compact Model for Carbon Nanotube Field-Effect Transistors Including Nonidealities and Calibrated With Experimental Data Down to 9-nm Gate Length** *IEEE TRANSACTIONS ON ELECTRON DEVICES*  
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Lee, D., Lee, W. S., Chen, C., Fallah, F., Provine, J., Chong, S., Watkins, J., Howe, R. T., Wong, H. P., Mitra, S.  
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  - **Design Strategy of Small Topographical Guiding Templates for sub-15 nm Integrated Circuits Contact Hole Patterns using Block Copolymer Directed Self-Assembly** *Conference on Alternative Lithographic Technologies V*  
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  - **Block Copolymer Directed Self-Assembly (DSA) Aware Contact Layer Optimization for 10 nm 1D Standard Cell Library** *32nd IEEE/ACM International Conference on Computer-Aided Design (ICCAD)*  
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  - **Stochastic learning in oxide binary synaptic device for neuromorphic computing** *FRONTIERS IN NEUROSCIENCE*  
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2013
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