

PREFACE

The Workshop on Frontiers in Electronics – WOFE-04 - that took place in Aruba, on December 17-22, 2004 - was the fourth in the series of the WOFE workshops. Seventy two leading experts from academia, industry, and government agencies came to Aruba to report on the most recent developments in their fields and to exchange views on future trends and directions of the electronics and photonics industry. The issues they addressed ranged from CMOS and SOI to wide band gap semiconductor technology, terahertz technology, and bioelectronics.

WOFE-04 provided a unique opportunity for the frank bold and original discussions, provocative (and sometimes controversial) presentations, and sharing visionary long-range outlooks. The emerged consensus was that CMOS technology will become a commodity in 10 to 15 years from now. Figure 1 clearly demonstrates that the developed countries will have a difficult time competing in a commodity industry.

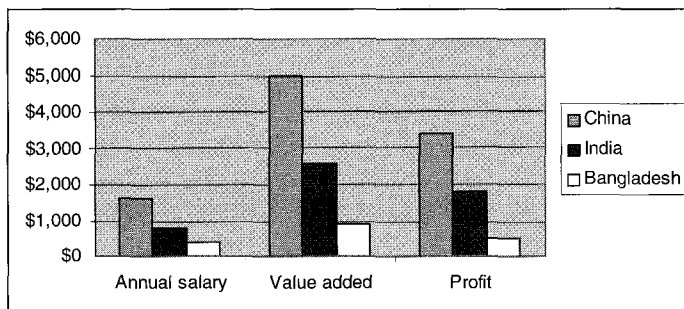


Fig.1 Wages, value added, and profits for textile workers in China, India, and Bangladesh (Data for 2001 textile industry from Time, December 13, 2004).

During the evening panel presentation on "Devices in 2035", Serge Luryi and the conference participants had commented on emerging shifts from pure research to research and development; from research on devices to research on systems; from fundamental and longer term research to applied and shorter term research; from small scale research to large interdisciplinary research projects; and from university research to industry/university collaboration, as CMOS scaling approach will end its life. They also noticed a growing demand for microelectronics research addressing societal needs, such as developing alternative sources of energy, protecting environment; providing security, and catering to aging population in the developed countries, such as US, Germany or Japan.

Nowadays, nanotechnology is one of the main foci of nearly every microelectronics conference, and WOFE-04 was not an exception. In that light, we have to heed the warning of Professor Herbert Kroemer, a Nobel Laureate, who wrote in his recent article¹:

"My skepticism pertains to the unbelievable hype that has arisen, during the last decade, about the "nano-whatever" field, a hype that exceeds anything I have encountered during my fifty years in solid-state physics and technology. The prefix *nano* suddenly gets

attached to everything (this conference is no exception), and we are deluged with predictions about fantastic future applications, often promised for the immediate future.”

The same thought, if not in form then in substance, is clearly present in Professor Wong’s paper published in these Proceedings. However, by all standards, CMOS technology is now nanotechnology, and one of the challenges addressed during WOFE was how to bring together multiple scales ranging from nano to macro (see Figure 2). Bridging these scales involves system applications, and major challenges here are summarized in the panel presentation comparing MOS ULSI and mosquito, which is more complex than even our most advanced ULSI (see Figure 3).

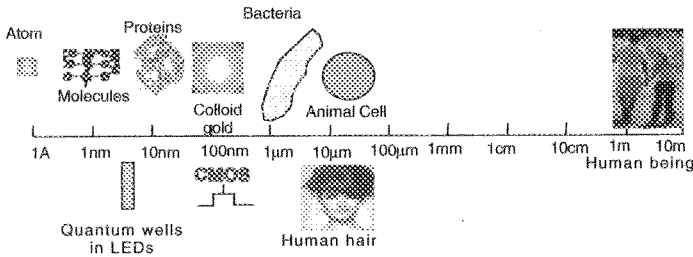


Fig.2 From nano to macro scales.

	MOS ULSI	MOSKITO
Element speed	ns	ms
Complexity	Approaching	10 ¹⁰ neurons (human brain)
Power consumption	Much larger!!!	Much smaller!!!
Intelligence	To be improved	Very smart (many sensors)

Fig. 3. Comparison of MOS ULSI and mosquito.

These Proceedings open with the paper by G. Shahidi of IBM who addresses the key question: “Are we at the end of CMOS scaling?” The paper by H. Iwai et al also deals with the future trends in CMOS technology. SOI devices (holding promise of whatever scaling might be still left for CMOS) are discussed in the papers by S. Cristoloveanu et al and Barin et al.

G. Bersuker et al, G. Lucovsky, and T. Hattori et al deal with materials issues important for deep submicron CMOS.

Nanoelectronics and bioelectronics issues are discussed in the papers by C.-Y. Chang C. H. S. P. Wong, K. Saraswat, Y. Wang, S. Deleonibus, H. Hasegawa et al, M. Lasater et al, and M. Stroschio and M. Dutta.

Many papers in the Proceedings consider novel non-silicon or (non-crystalline silicon) materials and devices. These papers range from those dealing with flexible and wearable electronics (S. Wagner et al, S. Lacor et al and T. Heal et al) to wide band gap electronics (Simin et al, B. Ozpineci et al, D. Ueda and T. Egawa, M. Hasanuzzaman et al).

Recent demands for new security technology have stimulated interest in the terahertz range of frequencies, and papers by D. Woolard et al, S. Luryi and A. Zaslavsky, L. Eastman et al, G. Solomon, W. Shi et al, M. Dyakonov and M. Shur, and L. Yan et al deal with new approaches to the terahertz technology.

On behalf of the WOFE Organizing, Program, and Steering Committees, we would like to thank all WOFE-04 participants and especially the invited contributors to this issue for making WOFE-04 a successful conference. We gratefully acknowledge generous support of this workshop by the US Office of Naval Research, US Defense Advanced Research Projects Agency, National Science Foundation, US European Army Research Office and IEEE EDS. Our special thanks go to the Members of Organizing, Program, and Steering Committees, and to Session Organizers for their tireless work and inspiration. Our special thanks go to Dr. Yoon Soo Park, Workshop Honorary Chair, Mr. George Narode, Treasurer, and Prof. Juin Liou, Local Chair who did everything humanly possible to make WOFE-04 a success. We are also grateful to Ms. Yuki Hashizume for her devoted contribution to the editing support work for the Proceedings.

H. Iwai, Y. Nishi, M. S. Shur, and H. Wong
The Editors

¹ H. Kroemer, "Nano-whatever: Do we really know where we are heading?" *phys. stat. sol. (a)* 202, No. 6, 957–964 (2005)