

## **Scalability of ST MRAM to Ultra-Small Sizes**

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Spin Torque Magnetic Random Access Memory is under intensive development by all major memory manufacturers. Progress in ultra-thin ferromagnetic materials allows to make ultra-small magnetic tunnel junctions which can be used to build high density MRAM memory. We demonstrated that a specific magnetic tunnel junction stack with perpendicular magnetic anisotropy is capable of delivering good performance up to  $WER=10^{-6}$  in a broad range of device size from 50 nm to 11 nm. Embedded ST MRAM has a chance to be a universal computer memory which can simplify chip architecture and memory management.

**BIO:** Dr. Janusz Nowak is Research Staff Member in Magnetoelectronics Division of Thomas J. Watson Research Center. Dr. Nowak received his Ph.D. in solid state physics from Institute of Physics, Polish Academy of Sciences in Warsaw, Poland in 1981. From 1978 to 1994 he was working on magnetic thin films, Lorentz electron microscopy and magnetic tunnel junctions in Department of Solid State Physics of Polish Academy of Sciences in Zabrze, Poland. In 1995 he joined Jagadeesh Moodera at Francis Bitter Magnet lab at MIT to continue research on magnetic tunnel junctions. In 1998 he began to develop ultra-thin barriers at Seagate (Minneapolis) for hard drive application. He developed first in the world functioning prototype of hard drive head reader made of ultra-thin magnetic tunnel junction. In 2004 he joined IBM research division in Yorktown Heights and begin to work on MRAM. His main fields of expertise are ultra-small magnetic tunnel junctions, MRAM device performance and functional testing of MRAM chips.