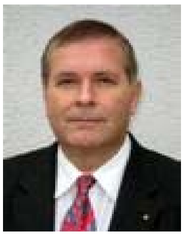
determined through the determination of the that on the substrate, which is then used to determine the fracture toughness for the thin film.

The method provides a novel way for precise measurement of fracture toughness of thin ceramic films. Neither a griping of a thin film, nor a specialized micro-Newton scale loading system is needed. The method is available for both ceramic and metal coatings. Case studies, such as DLC films, CN coatings, Si coatings, SiO coatings, as well as Al coatings and amorphous metallic coatings are presented.



Prof. Dr. Siegfried Selberherr
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"Giving Silicon a Spin"

The spectacular increase of computational speed and power of modern integrated circuits is supported by the continuing miniaturization of semiconductor devices' feature size. With scaling approaching its fundamental limits, however, the semiconductor industry is facing the challenge to introduce new innovative elements and engineering solutions and to improve transistor performance. A promising alternative to the electron charge degree of freedom currently used in switches and memory is to take into account the electron spin.

The spin of an electron possesses several exciting properties suitable for future devices. It is characterized by only two projections on a chosen axis – up or down, and it can change its orientation rapidly by utilizing an amazingly small amount of energy. Employing spin as an additional degree of freedom is promising for boosting the efficiency of future low-power nanoelectronic devices, with high potential for both memory and logic applications.

The theoretical predictions and the experiments of spin torque transfer switching showed that the random access memory based on this effect is one of the candidates for future universal memory concept. The main challenge is the reduction of the current density required for switching accompanied with the increase of the switching speed. We demonstrate that a 5 layers magnetic tunnel junction with the two fixed layers allows reducing the switching current density.

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"Label-Free Biosensing with Silicon Nanowires"

Nanoscale electronic devices have the potential to achieve exquisite sensitivity as sensors for the direct detection of molecular interactions, thereby decreasing diagnostics costs and enabling previously impossible sensing in disparate field environments. Semiconducting nanowire-field effect transistors (NW-FETs) hold particular promise, though contemporary NW approaches are inadequate for realistic applications. We present here a number of top-down fabricated nanowire approaches [1] that are compatible with complementary metal-oxide-semiconductor (CMOS) technology that has not only achieved unprecedented sensitivity, but simultaneously facilitates system-scale integration of nanosensors. These approaches enable a wide range of label-free biochemical and macromolecule sensing applications, such as specific protein and complementary DNA recognition assays, and specific macromolecule interactions at $<$femtomolar concentrations. We will also discuss the physics of FET sensing, and device-related limits of potential detection [2].

A critical limitation of nanowire sensors is the Debye screening issue [3] which has to date prevented their use in clinical applications and physiologically relevant solutions. We will present an approach that solves this longstanding problem, and demonstrate the detection at clinically important concentrations of biomarkers from whole blood samples [4].

[1] Nature, 445, 519 (2007)
[2] Elect. Dev. Lett. 31, 615 (2010)
[3] Nano Lett. 7, 3405 (2007)
[4] Nature Nanotech. 5, 138 (2010)