Oxides for integrated electronic or photonic technologies

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Research on oxide materials has been since long a field of intense investigations, in particular for Information and Communication Technologies. This area of research has been driven since the beginning from both a scientific and a technological perspective. In the initial phase 30 years ago, the scientific community nucleated around the research on high-Tc superconductivity, and since then expanded towards other materials and challenges. In a more recent second phase, substantial work has been dedicated to the exploitation of oxide's superior properties in *real* technologies

The quest for a replacement gate dielectric in field effect transistors has been a powerful driver to progress in this direction. Replacing SiO_2 at the heart of Metal-Oxide-Semiconductor Field-Effect-Transistors was a major challenge for the microelectronic industry. To solve this challenge, disruptive approaches have been considered, e.g. with single crystalline oxides directly on semiconductor surfaces. My presentation will review the incentives to develop such technologies, highlight the major challenges and achievements, and give a perspective on the need for new materials and devices for future microelectronic technologies. However, the combination of silicon microfabrication techniques with the capability to grow crystalline directly on silicon opens up perspectives for completely different fields, as for example in integrated photonics.

Photonics has been the backbone for long range data communication since many years. The need for bandwidth droves the development towards a tighter integration of electro-optical systems, and silicon photonics became the baseline technology. As a key asset for the future of information and communication technology, silicon photonic integrated circuits will greatly benefit from the integration of novel materials. Several oxide materials have very interesting optical properties and can nowadays be integrated with silicon while maintaining their superior optical characteristics. Polar materials such as ferroelectric oxides fall into this category. Such materials are extremely relevant because they are already in use as discrete components for long range communication, e.g. using $LiNbO_3$ for electro-optical modulators. However, unless one can integrate such materials into silicon photonics, modulators will be limited to the use of the plasma dispersion in silicon. I will then also review recent work accomplished to integrate $BaTiO_3$ in various photonic devices monolithically integrated with a silicon photonic platform.