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From GaAs MOSFETs to epitaxial oxides on silicon : old and new MBE stories.

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50 years of intense development in chip technology did not fundamentally change the initial concept: the capability to modulate charges right at the interface between two dissimilar materials. This concept allowed the whole microelectronic industry to develop exponentially and to disseminate its products all over our environment. Two simple reasons can be given to such a success: i) device scaling was a simple and cost-effective method to make chip faster; ii) faster chips simply allowed our computing environment to perform new functions. None of the two reasons given will remain true in the next few years. Scaling has come to an end. The materials properties will be scaled instead of the device itself. The recent introduction of high-k materials perfectly illustrates such a transition. The future success for chip makers might then depends on new rules: i) many new materials will be developed, and interfaces, still a key element for a device to perform better, will multiply; ii) The future technology developments will be more expensive and generate smaller performance gains. The added value might be then in the integration of functions implemented in these new materials. A few years ago, molecular beam epitaxy allowed band-gap engineering in compound semiconductors to build new devices and, more recently, was successfully used to explore the physics and chemistry of complex perovskites. During the last years, new developments have been made to combine oxides and semiconductors. In particular, many groups have reported the growth of epitaxial oxides on silicon surfaces. The recent and renewed interest in compound semiconductor MOSFETs structures might indeed be seen as a logical conclusion for this evolution. This presentation will review the latest developments in the field, with a focus on the activities taking place at IBM Zurich. It will also put them in perspective with the new rules the microelectronic industry might follow.