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### Photosensitive metal-insulator-metal like capacitor on silicon with SrFeO-F nano particles embedded in the insulator stack

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We have demonstrated a new type of varactor comprising a metal-insulator-semiconductor (MIS) structure, which incorporates Fe mixed with SrF<sub>2</sub> nanoparticles (NPs) like SrFeO-F, embedded in an insulator stack, between thermal SiO<sub>2</sub> and atomic layer deposited (ALD) HfO<sub>2</sub> sub-layers. This is the consequence of the ALD and rapid thermal annealing processes, which initiate the fluoridation-oxidation and crystallization of the electron-beam gun deposited SrF<sub>2</sub>-Fe-SrF<sub>2</sub> sub-layers, which was seen in electron energy loss and energy dispersive X-ray spectroscopy measurements, resulting in the formation of high-density positive charge sites of the oxygen reduced Fe ions, which, in turn, induce dipole-type traps with electronic polarization. Measured capacitance is bias-independent, which resembles the behavior of a metal-insulator-metal (MIM) diode; except that, here, the capacitance depends on illumination and exhibits a strong frequency dispersion. Due to large density of traps at the interface, there is significant band-bending at Si-interface irrespective of the applied voltage (due to pinning of the Fermi level), causing the formation of interfacial inversion layer, playing role of the second electrode. The capacitance is enhanced in the presence of illumination, while capacitance dispersion is rather conventional, reducing with increased frequency. The varactor exhibits extremely low quadratic voltage coefficient. The obtained characteristics are compared with two other MIS structures, one containing Fe but no SrF<sub>2</sub> sub-layers, which behave as non-volatile memory system with large hysteresis of 7 V; and another that contains only the SiO<sub>2</sub> and HfO<sub>2</sub> stack, which has conventional MIS capacitance-voltage characteristics with extremely low hysteresis of 0.3 V. The proposed MIM like capacitor is compatible with standard CMOS technology and can be prepared at relatively low temperatures. Additionally, it can be integrated within different optoelectronic circuits operating at moderate frequencies.

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### Zeolite molecular sieves: Present trends and prospects

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Porous materials are those permeable to fluids due to the presence of pores. Among different groups of materials, the zeolite type materials have the biggest impact on the modern society. Zeolites are crystalline microporous crystals with well define pores with size below 2 nm, large micropore volume and specific surface area, tunable active sites and unique shape selectivity. These properties make zeolites indispensable catalysts and molecular sieves in petroleum refining, petrochemical industry, protection of the environment and as a component of different products used in the household. In the future, their impact will widen and be felt in the processing of heavier fossil and renewable feedstocks, optical and medical applications. The diversified feedstocks, together with the changes in the products demand and environmental regulations, make the design and engineering of zeolite based materials a complex task. In order to address new challenges detail insights in the structure-property relationship of zeolite molecular sieves are indispensable. The talk will provide an overview of the current developments in the field of zeolite-type materials. Both, *in-situ* and post-synthesis methods of modification of zeolite molecular sieves will be addressed. The advances in the understanding of the nucleation/crystal growth process will be discussed and example how the new knowledge serve to obtain zeolites with predetermined properties will be given. Post-synthesis methods for control of the physicochemical properties of zeolites will also be addressed. For instance, a drawback in the use of zeolites is the restricted diffusion, which is commonly associated with the sub-nanometer size of their pores where the active sites are located. The post-synthesis methods that allow overcoming this roadblock to the more efficient use of zeolites will be overviewed. Finally the complementarity between *in-situ* and post-synthesis methods with the goal to overcome the natural limits and obtain unique zeolitic materials will be addressed.

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