7-1 *INVITED*: MOS EFFECTS AND SILICON DEVICE TECHNOLOGY

E. Kooi

Philips Research Laboratories

Eindhoven-The Netherlands

During the past decade a large amount of research has been carried out on the properties of oxidized silicon stimulated mainly by the desire to produce reliable MOS devices. At the moment the influence of the oxide preparation method and annealing treatments as well as the effects of various impurities on the properties of the $Si\text{-}SiO_2$ interface are fairly well known. However, a completely satisfying phisical-chemical model, which could explain all the observed phenomena, is still a point of discussion. Oxide charge, interface states, the doping level of the semiconductor substrate and the oxide thickness are variables which can be used to control such an important parameter as the threshold gate voltage of an MOS device. Amongst others, poly-siiicon gate techniques have appeared to be very suitable to produce reliable MOS devices, both from the point of view of technology (self-aligned gates) and threshold voltage control.

In many semiconductor devices, particularly in integrated circuits, parasitic MOS effects may occur and have to be prevented by a proper choice of the technology. Regulation of oxide thickness, oxide charge and/or surface states and/or the doping level of the semiconductor substrate under the passivating oxide-films may be employed. Diffused guard rings and field-relieve electrodes are effective means to make devices which should be able to operate at relative high voltages.

The LOCOS (local oxidation of silicon) technique[1] is extremely suitable to produce well-defined thick patterns of silicon oxide, which are sunk to at least part of their thickness into the silicon substrate. Usually silicon nitride films are used as oxidation masks. The technique is very suitable for producing densily packed bipolar as well as unichannel and complementary MOS integrated circuits. One of the advantages is also that parasitic MOS effects can be reduced because (1) the oxide layers can be made thick, (2) the impurity concentration under the oxide can be regulated in a self-registered fashion, (3) various regions of impurity diffusion, such a base diffusion, guard-ring diffusion, isolation diffusion can be determined by different windows in the LOCOS pattern, defined already by the silicon nitride pattern which is used as the oxidation mask.

1) Philips Research Repts. 25, 118, 1970 and 26, 157 and 166, 1971