

**INVESTIGATION ON THE OH INFLUENCE
FOR THE DIELECTRIC CONSTANT
EVOLUTION IN LOW K FILMS PREPARED
BY PECVD IN DECR REACTOR**

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In ULSI device where critical dimension, continue to shrink to the deep submicrometer range, many problems appear caused by the RC parasitic constant. As the device become smaller and smaller, the electrically conducting interconnect lines start to influence each other. One promising solution to overcome this difficulty is to use an insulating material with lower dielectric constant than the ones used presently (SiO₂). Shimoyama [1] have shown that the hot carrier tolerance of metal-oxide-semiconductor (MOS) devices is strongly affected by water. Takahashi [2] reported that the disappear of OH induce a reducing of defect density. HMDSO/O₂ mixtures plasma are used to deposit SiO_xC_yH_w films in multipolar microwave plasma reactor (MMP-DECR, 2.45 Ghz). FTIR spectrometer is used to look into the influence of OH incorporation on the evolution of the dielectric parameters. Electrically measurements are made on the films deposited on the intrinsic silicon to follow and compare the OH evolution and the electrically tendency. The infrared spectra shows a decrease of OH bond area in SiO₂ films versus the injected power. At the same time, the permittivity of the film become lower and lower. The decrease of OH amount inside materials tend to a decrease of the dielectric constant of the film. As oxygen addition in plasma mixture, the film composition changes and the comparison of OH area evolution in the FTIR spectra and the dielectric loss illustrates a same behavior too. The dielectric loss (Tgδ) measurements reaches a maximum around 70% of O₂ in the mixtures and then decreases to a lower value around 5.10⁻⁴at 90% O₂. Interfaces states density of the MIS structures elaborated by these deposited films under different plasma discharge power have been studied. The study revealed a reduction of near a decade of N_{ss} when the discharge power increases from 200 to 500 watts. Elsewhere, as function of oxygen addition, the Nss has the same drop at 90% O₂ in HMDSO/O₂ vapors. It appears that incorporation of water molecules (hydroxyl bonding) and/or silanol groups (Si-OH bonding) in these elaborated films has an influence in the Nss increase, therefore in dielectric parameters. At the same film composition OH amount could be an interesting parameter to control the permittivity of the film. As oxygen addition in the mixtures, although the OH permittivity is very high (ε ≅ 80), it not constitute a largest parameter for dielectric evolution [3], but form a determining factors for trap generation inside the films.

1. N. Shimoyama, K.Mashida, K. Murase and T. Tsuchiya, proceedings of 1992 symposium on VLSI Technology (business Center for Academic Societies Japan, Tokyo, 1992) 94
2. J-i. Takahashi; K. Machida; N. Shimoyama and K. Minegishi, Appl. Phys. Lett 62 (19) 1993
3. A. Zenasni; P. Raynaud ; S. Sahli; S. Rebiai; and Y. Segui. Published soon in “ Surf. Coat. Tech”

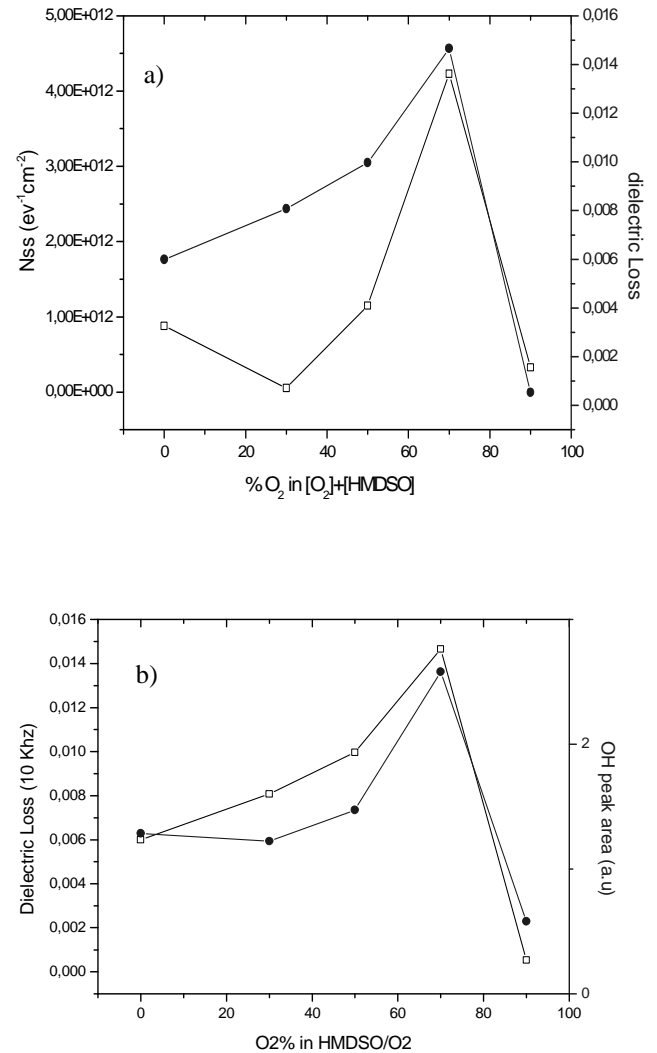


Fig1. OH peak area evolution versus oxygen addition in HMDSO/O₂ mixtures in comparison with a) density of state (Nss) and b) the dielectric loss.