IMPACT OF SURFACE STATE CHARGE ON ENHANCEMENT AND DEPLETION DEVICES

An experiment was conducted using the 9063 test mask in which the metal was delineated on half of each wafer before sintering so that one half of the wafer was pre-sintered in accordance with our standard process, while the other half was post-sintered: thus the differences between the two classes of devices was due to surface state charge variations. Generally speaking, the post-sintered devices had lower threshold voltage and higher depletion device currents, each of these corresponding to a higher surface state charge. Attached hereto are the data as measured resulting in the graph of changes in ON current for the depletion devices vs. decreases in threshold voltage for the enhancement devices. A reasonably good correlation results showing a linear dependence between depletion current changes and enhancement threshold changes, with a ratio of 70 μA of depletion device current change for 500 mV of enhancement device threshold voltage change.

It should be emphasized that 500 mV is <u>not</u> the expected range of variation of threshold voltage for the enhancement devices through our standard product since this range was artificially generated by using post-sinter instead of pre-sinter. Instead, the correlation data presented can be used to forecast the current variation in depletion devices for whatever variation is observed for enhancement devices insofar as the impact of surface state charge is considered as a separable variable. It is assumed for the experiment conducted that the oxide thicknesses are uniform across each wafer as were all implants.

The various devices measured have the following differences:

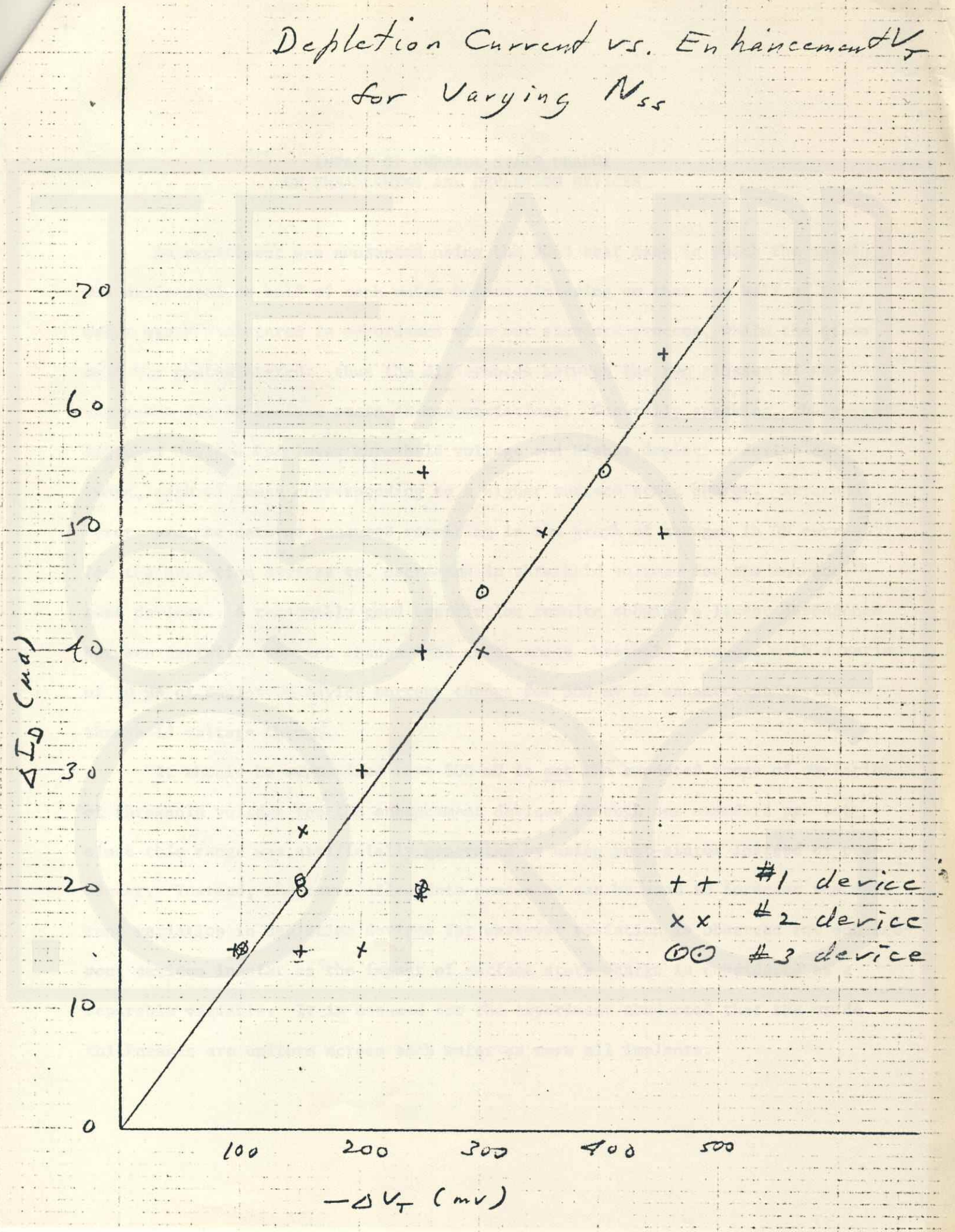
1) Device #1 has the poly gate connected to metal bonding pad but is connected to no diffusion in the vicinity of the device.

2) Device #2 has the poly gate connected to an aluminum bonding contact and is also connected through an aluminum strap to a diffusion in the vicinity of the device.

3) Device #3 has the poly gate connected directly to a diffusion in the vicinity of the device using a poly/N^+ contact and uses poly to come out to a bonding contact.

In this experiment, as in some previous experiments conducted, no significant difference is observed between these three classes of devices so that no modification has to be incorporated into circuit design for one type of device model vs. another.

Depletion Current vs. Enhancement V_T for Varying N_{ss}



Lot #019-250

		Depletion Current		Enhancement V_{Te}			
Wafer	Device	Post-Sinter	Pre-Sinter	Post-Sinter	Pre-Sinter	ΔI_{DON}	ΔV_{Te}
2	1	170 µA	140 µA	750 mV	950 mV	30 µA	-200 mV
	2	160	135	800	950	25	-150
	3	160	140	800	950	20	-150
2	1	150	135	850	950	15	-100
	2	150	135	850	950	15	-100
	3	150	135	850	950	15	-100
4	1	170	130	800	1050	40	-250
4	1	140	120	900	1150	20	-250
	2	140	120	900	1150	20	-250
	3	140	120	900	1150	20	-250
5	1	215	150	400	850	65	-450
	2	200	150	550	900	50	-350
	3	210	155	450	850	55	-400
5	1	185	135	600	1050	50	-450
	2	175	135	700	1000	40	-300
	3	180	135	700	1000	45	-300
6	1	155	100	800	1050	55	-250
	2	155	140	850	1050	15	-200
6	2	135	130	950	1100	5	-150
	3	120	100	950	1100	20	-150