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GaAs X-BAND POWER FET

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Following successful results in low noise amplifiers, it has been demonstrated that GaAs FET's have also excellent potential as microwave power devices. At the beginning of 1973, the GaAs FET only showed its possibility as a power device, but at the end of 1974, it became the first three-terminal solid state device that broke through the X-band 1W barrier.

This paper presents some relations between electrical characteristics of a power FET and the quality of GaAs epitaxial wafers, and some anticipations of future FET's.

It has been reported that a small signal GaAs FET with a buffer layer between an n-type layer and the semi-insulating substrate, exhibits a lower noise figure and a higher gain than that without the buffer layer.(1) But it has not clearly explained why the buffer layer has so important effects on electrical characteristics of the FET.

In order to compare the qualities of epitaxial layers with and without the buffer layer, "absolute mobility profiles" in the interface region of the epitaxial layers were measured. It was found that as shown in Fig. 1, there is sometimes a space charge scattering region near the interface of the n-type epitaxial layer without the buffer layer, but it can be minimized by the sequent growth of the n-type layer on the buffer layer in one step.(2)

Figure 2 shows the scanning electron micrograph of the assembled power FET. The linear gain of the power FET has been improved by about 4 dB at X-band (9 dB) by introducing the buffer layer. We believe now that the space charge scattering near the interface of the epitaxial layer, decreases transconductance g_m and increases drain conductance g_d of the FET. See Fig.3.

These data suggest that it is possible to develop a K-band power FET in the near future, with continuing research ahead to improve GaAs epitaxial process, and design theory and fabricating process of the FET.

(1) T. Nozaki et al. "Multi-layer Epitaxial Technology for The Schottky Barrier GaAs Field-Effect Transistor" 5 th Int. Symposium on GaAs and Related Compounds, Sept. 1974
(2) A. Shibatomi et al." Characterization of Interface Region in VPE GaAs" to be presented at the 3rd Int. Conference on Vapor Growth and Epitaxy

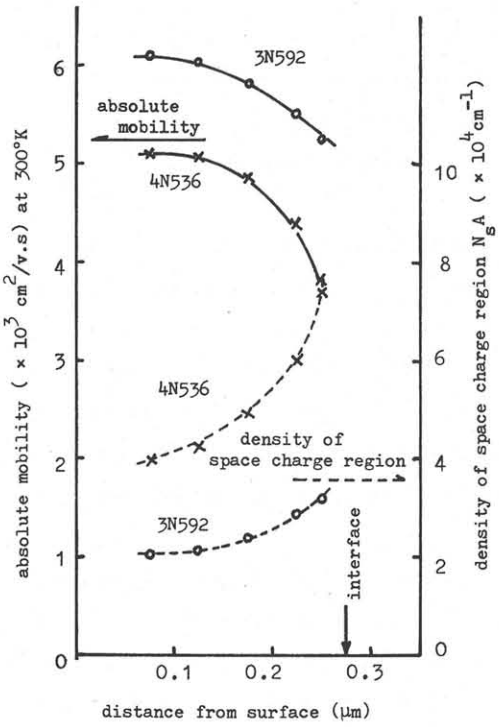

Fig. 1 Absolute mobility profiles and density of space charge region. 3N592: with Fe doped buffer layer. 4N536: without the buffer layer. Carrier density of both sample is about $5 \times 10^{16} cm^{-3}$.

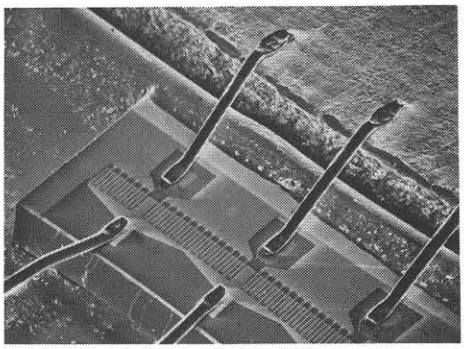

Fig. 2 Scanning electron micrograph of the assembled power FET.

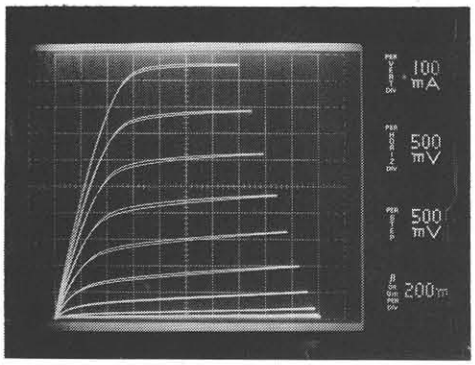

Fig. 3A V-I characteristics of a power FET with the buffer layer.

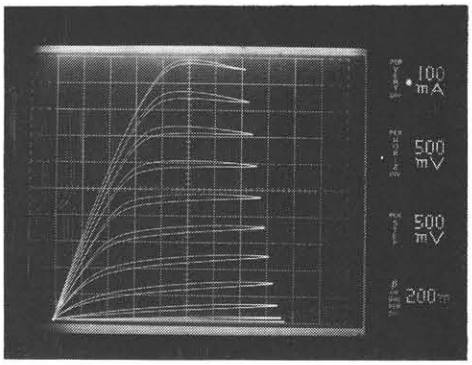

Fig.3B V-I characteristics of a power FET without the buffer layer.