Low Frequency Noise versus Temperature Spectroscopy of Si and Ge JFETs

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The measurement of low frequency noise vs. temperature is a powerful method for the determination of traps in field-effect transistors (FET's). Energy levels and eventually trap cross-sections could be derived from noise spectra taken at different temperatures. This approach, known in literature as Low Frequency Noise versus Temperature Spectroscopy (LFN vs T) [1],[2] is not widely employed but shows important advantages compared to Deep Level Transient Spectroscopy (DLTS): LFN vs T is able to evaluate the parameters of the impurities responsible of the noise observed in a device biased and cooled in its actual operative conditions. Typical devices of interest are JFETs used in the signal amplification of infrared and visible sensors or particle detectors, used on the ground or in space-borne instruments. Moreover, LFN vs T can be used at very low temperatures, where carrier freeze-out inhibits DLTS. LFN vs T technique, yielding the noise power spectrum for every operative temperature, is a useful tool for the development of low noise devices as it produces data for process characterization and modeling.

We have performed LFN vs T measurements on a commercial Si JFET and also during the investigation of cryogenic properties on a recently developed Ge JFET[3], analyzing the traps that originate lorentzian noise.

To perform this task we have developed a computer controlled experimental setup able to set the temperature within +/- 5 mK in the range 4K-300K during a spectral noise measurement [4].

We will report on the results obtained.

[1] F.J. Scholz and J.W. Roach, Low Frequency Noise as Tool for characterization of Near-Band Impurities in Silicon, Solid State Electronics, Vol 35 No 4 pp447-452,1992.

[2] Brian K. Jones, Low Frequency Noise Spectroscopy, IEEE Trans. On Electron Devices , Vol 41 No 11 Nov 1994 , pp 2188-2197.

[3] R.R.Ward, R.K. Kirschman, M.D. Jhabvala, R.S. Babu, N.C. Das, D.V. Camin, V.Grassi ,K. Kandiah and J.J. Rosemberg,Development of Cryogenic Ge JFETs- III 4th Workshop On Low Temperature Electronics, ESA proceedings WPP-171(2000), pp 105-111.

[4] D.V. Camin, C. Colombo, V.Grassi, G.Pessina, Automatic System for DC and Noise Characterisation of Solid State Devices in the Range 4K-300K, 4th Workshop On Low Temperature Electronics, ESA proceedings WPP-171(2000), pp 151-155.