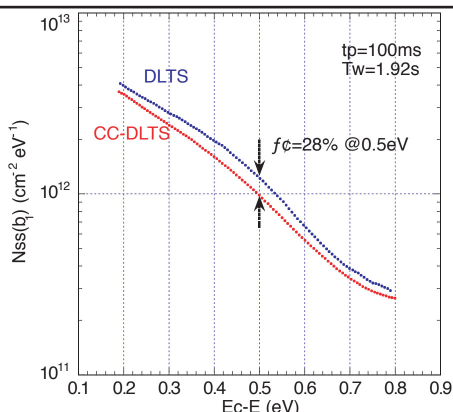
CERAMIC FORUM

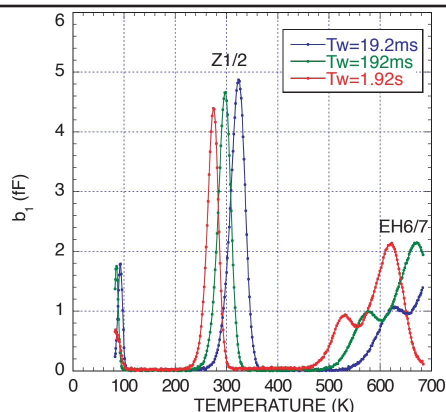
DLTS Measurement Service

SiC-MOS interface state (DLTS/CC-DLTS comparison)

The normal DLTS method shows an overestimation of the interface state concentration (Δ = 28%, @ 0.5 eV).

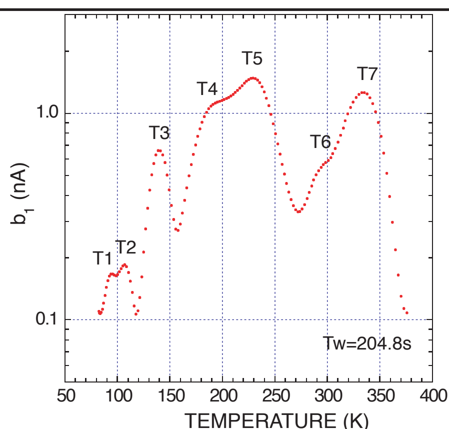


DLTS spectrum of SiC epi-layer



PITS spectrum of semi-insulating GaAs

The existence of seven levels is indicated by T1~7.



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About the DLTS (Deep Level Transient Spectroscopy) Method:

Since the characteristics of semiconductor materials are greatly affected by quite small amounts of impurities and lattice defects (crystal defects), defect evaluation is extremely important.

The DLTS method is an excellent technique to detect with high sensitivity the electronic state (deep level) created by crystal defects. Devised by Lang of Bell Laboratories in 1974, it continues to be widely used.

In this method, samples having a so-called semiconductor junction (a Schottky or pn junction etc.) are used. By monitoring the dynamic process by which the carrier (e.g. electron) trapped in the deep level is emitted into the band (conduction band), the parameters (energy levels, capture cross-section) and concentration, spatial distribution etc. of the level can be determined through the transient changes in the junction capacitance of the sample.

The DLTS method is not only effective for measurement of discrete levels produced by single atomic size defects, it can also be used for evaluating interface states in MOS structures and continuum levels in amorphous semiconductors.

The DLTS system we sell and utilize for our measurement service is a product of Phystech GmbH, a specialized manufacturer of DLTS measuring equipment spun-off from the University of Kassel, Germany.

Phystech has succeeded in the development of the only digital system among all the DLTS systems available for sale, the world's most popular DLTS measurement system.

The FT-1230 released in 2016, in comparison with competitive products, has the most diversified measurement modes, and is the only system capable of the scale necessary to meet requests from researchers to measure all kinds of materials.

Features of our Measurement / Analysis Service

(1) Serving a Wide Range of Measurement Needs

Although the DLTS method is certainly a highly sensitive means of measurement, the physical properties of semiconductors are diverse. For example, in so called semi-insulating semiconductors and ultra-thin layer semiconductors with depletion layers covering the whole sample, transient changes in junction capacitance can no longer be measured and normal capacity DLTS method is ineffective.

In such samples, the current mode based PITS method and TSC method are effective. The FT1030 is our standard measurement system, as it can meet a wide range of measurement needs according to the physical properties of the sample.

(2) Supported by Professional Engineers

The professional engineers in charge of our measurement / analysis services have been involved for many years in semiconductor R & D, as well as defect evaluation by the DLTS method. Defect levels may often exhibit complicated phenomena such as metastable behavior etc. making it difficult to interpret DLTS measurement results. With their abundant knowledge and experience, our staff can solve such problems.

Example of HERA deconvolution on DLTS spectrum.
In this spectrum, a1 (correlation function of cosine) analysis was done. Then, the relationship between each set of thermal emission time constants and temperature is obtained for each of the two proximity levels.

Fig.: Separation of adjacent peaks in DLTS spectrum (a1) by HERA analysis
(□: data point,
green: peak separated by deconvolution,
red: fitting result)