

**【Grant-in-Aid for Scientific Research (S)】**  
**Science and Engineering (Engineering)**



**Title of Project : Origin elucidation of problems in interface electric charge transportation phenomenon by using scanning nonlinear dielectric microscopies**

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Research Project Number : 16H06360 Researcher Number : 40179966

Research Area : Electrical and electronic engineering

Keyword : Scanning nonlinear dielectric microscopy, Interfacial electric charge transfer, Local DLTS

**【Purpose and Background of the Research】**

Interfacial charge transfer effects have been commonly and frequently used in great number of electronic devices including SiC-MOS devices. However, the interfacial (or channel) electron mobility of such devices has been much less than that expected from the theoretical values and this is their common problem now. Although this problem is the large obstacle for obtaining high performance next generation electronics devices, unfortunately, it has not been solved for a long time, yet. The main reason why the problem has been unsolved is that the origin of low interfacial charge mobility is unknown due to the lack of the local and nondestructive investigation methods for evaluating such interfaces.

To obtain such local and nondestructive method, we will newly develop several multifunctional and high performance scanning nonlinear dielectric microscopy (SNDM).

Using these SNDM, we will clarify the origin of several problems in interfacial charge transfer effects. Then, based on the obtained knowledge, we will achieve great improvement in the performance of electronics devices.

**【Research Methods】**

At first, we will newly develop several multifunctional and high performance SNDM. In particular, SNDM for local DLTS (Deep Level

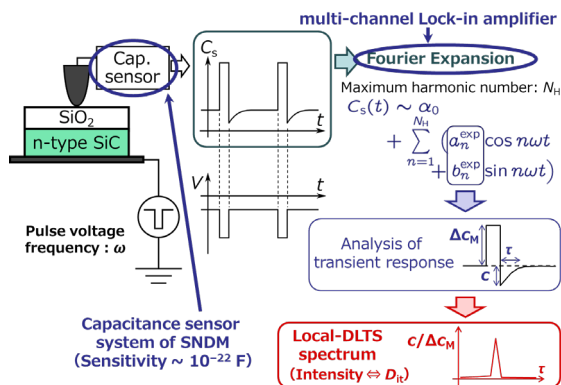


Figure1 Principle of proposed local DLTS method

Transient Spectroscopy) method, scanning

nonlinear dielectric para-magnetic resonance microscopy (SNDMR) will be newly developed. Moreover, we will make further advancement of the performance of recently developed scanning nonlinear dielectric potentiometry (SNDP), noncontact-scanning nonlinear dielectric microscopy (NC-SNDM) and super higher order scanning nonlinear dielectric microscopy (SHO-SNDM). Combining and using these high performance SNDM series, we will clarify the origin of the interface state density and scattering defects that degrade the channel carrier mobility by measuring and evaluating the interfaces employed in targeting devices.

**【Expected Research Achievements and Scientific Significance】**

We will clarify the origin of several problems in interfacial charge transfer effects. Then, based on the obtained knowledge, we will achieve great improvement in the performance of electronics devices by feed backing the obtained knowledge about the origin of degradation of interface qualities to the fabrication processes. Thus, we will be able to fabricate new high performance device with quite high channel electron (career) mobility.

**【Publications Relevant to the Project】**

K. Yamasue and Y. Cho, Rev. of Scientific Instrum., Vol.86 (2015) pp. 093704-1-8  
 N. Chinone, T.Nakamura and Y. Cho, “J. Appl. Phys., Vol.116 (2014) pp.084509-1-7.

**【Term of Project】** FY2016-2020

**【Budget Allocation】** 149,700 Thousand Yen

**【Homepage Address and Other Contact Information】**

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