

Charge Transport Characteristics in Time Domain

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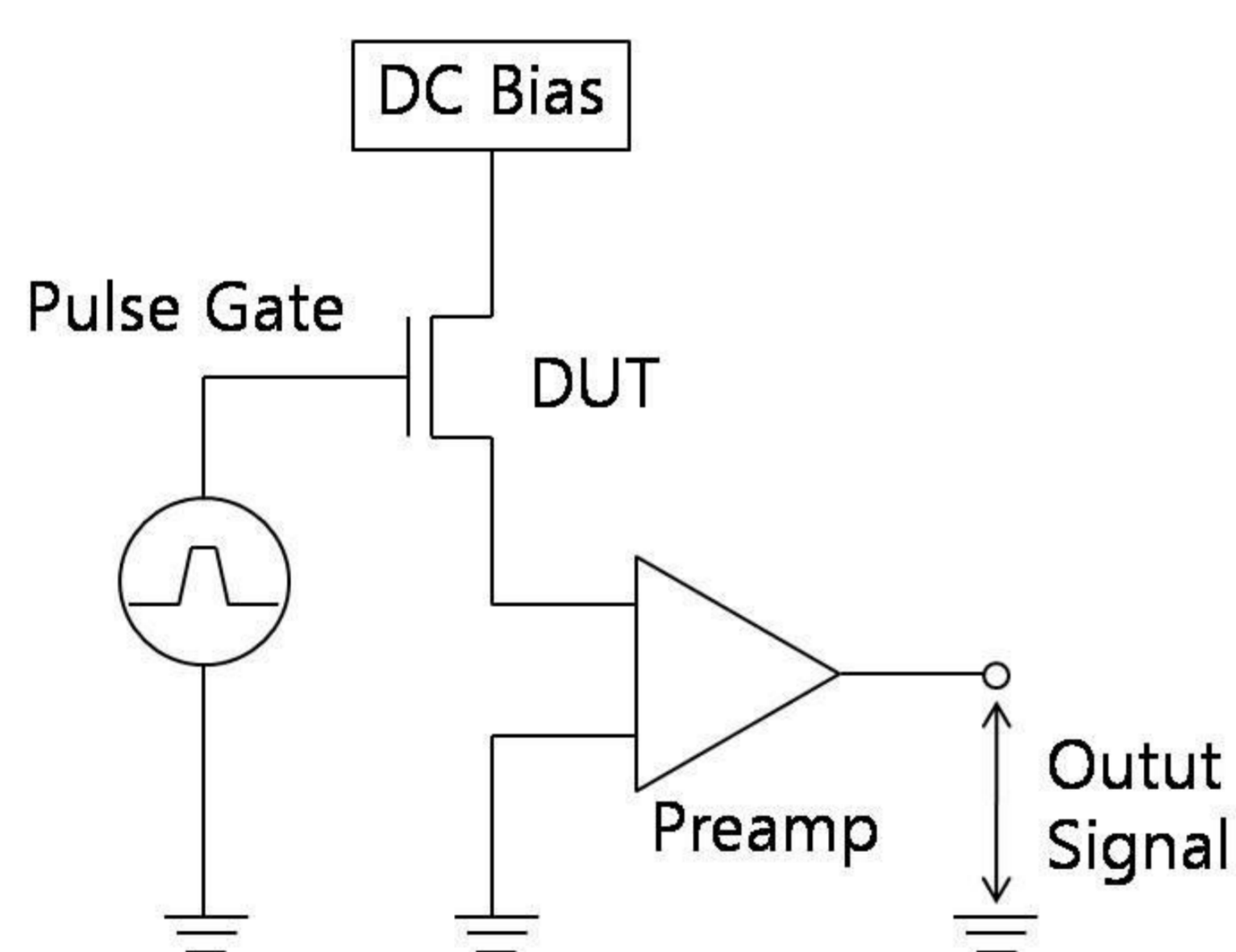
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1. Motivation

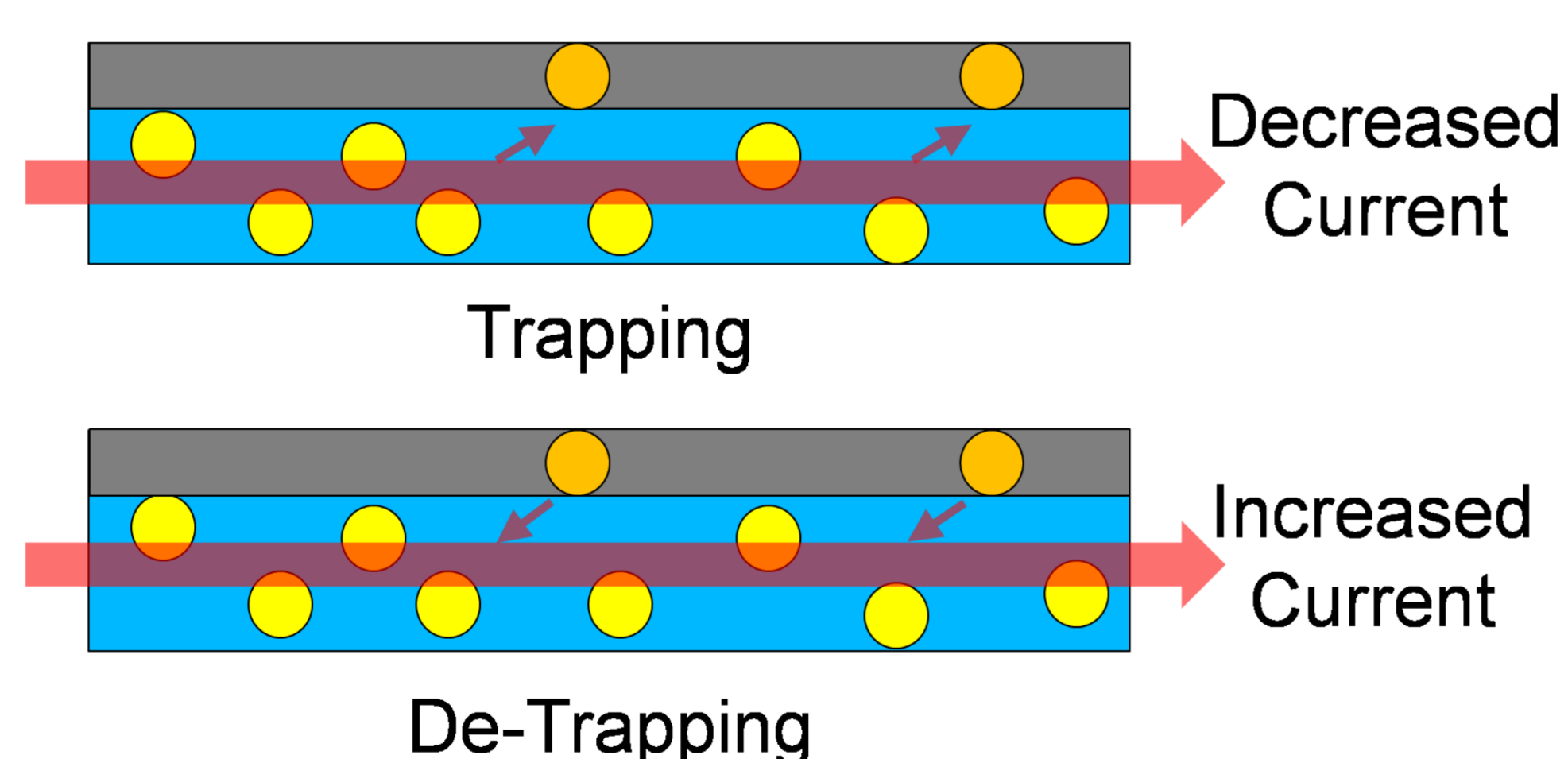
Currently, for the alternative devices of the traditional CMOS technologies, new challenges have been tried, for example, nanowire FET, finFET, the high K gate dielectric, etc. The biggest issue is concerned with device dimension. Due to new architectures and processes, the charge trap density becomes more effective for device operation.

2. Measurement Scheme

For the quantitative analysis of the charge trap density of the FET, time transient current measurements system is on preparing. The pulse signal is used for the gate input. DC bias was given in the linear region of the device operation. For the measurement of current output, a current pre-amp and oscilloscope is used. [1]



The current output can be changed by the shape and the width of the gate pulse. Especially, in this case, the threshold voltage shift is shown from the output current hysteresis. If the pulse width is not long enough for the capture or the emission of holes and electrons, the quantity of trapped charge is variable. It makes additional charges. The trap charges disturb the flow of charges and it becomes the origin of the hysteresis current.[2]



4. Discussion

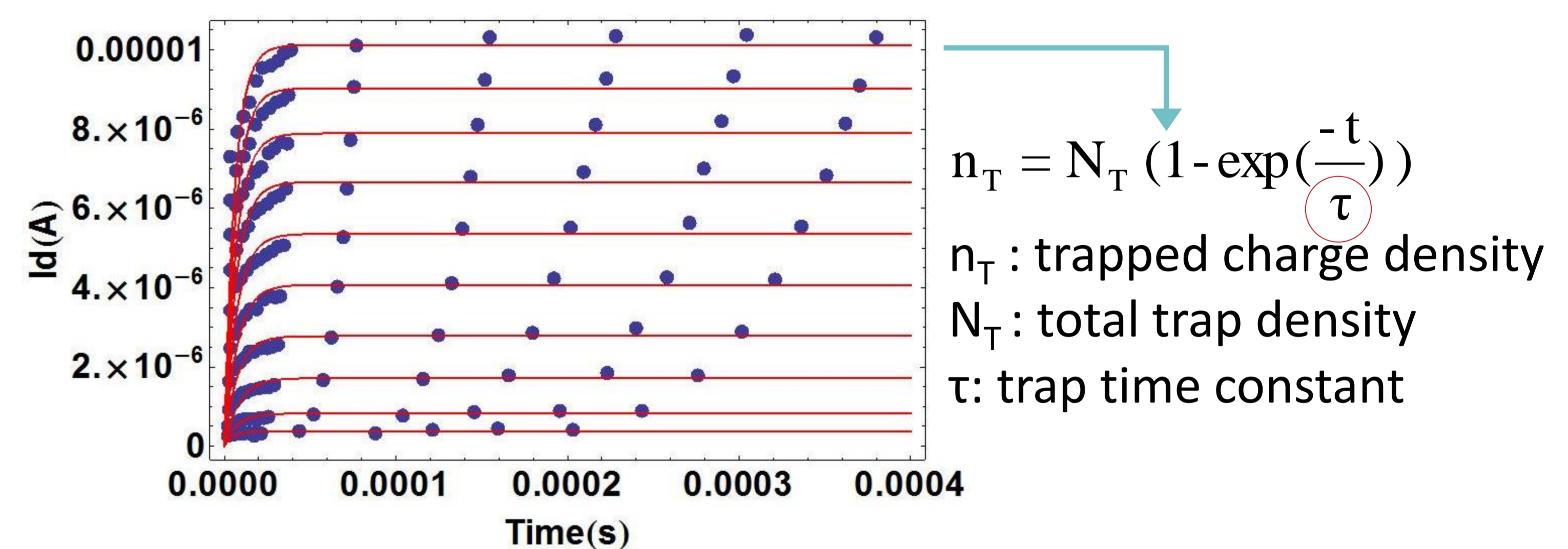
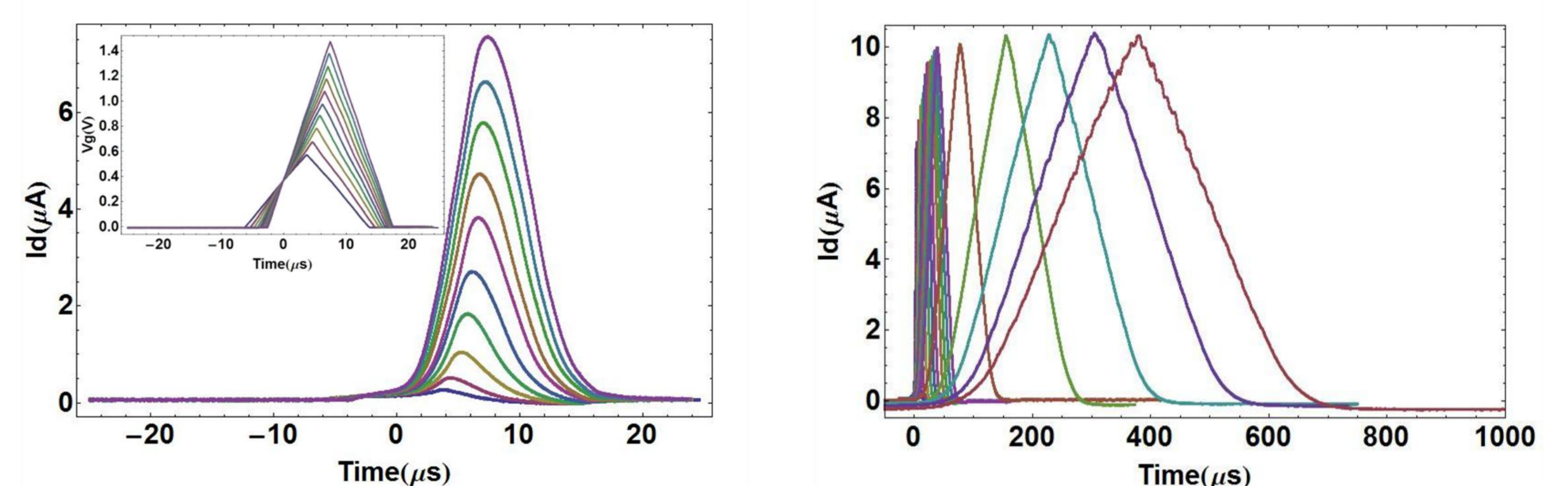
Analytic model should be confirmed properly. Previously, several analytic models for charge trapping have already been developed. However, concerning with the device structures and properties, it should be modified. From the well fitted model, this measurement method must be useful to understand the transport of the advanced devices and to develop new device fabrication technique.

5. References

- [1] G. RIBES et al. IEEE Transactions on Device and Materials Reliability, Vol. 5, No. 5, pp.5-19, (2005)
- [2] J. Mitard et al. IEEE International Reliability Physics Symp. pp. 174-178, (2006).
- [3] S. Zafar et al. IEDM Tech. Dig., pp.517-520, (2002)

3. How to Analyze

The time constant of capacitance can be calculated by the differences of maximum current.



From the threshold voltage shift and the time constant, the total trap concentration can be obtained. [3]

