ShanghaiTech GaNology Lab
氮化镓电子器件实验室

SiC SBD studied by DLTS

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Outline：

- **Fresh SiC diode DLTS test：**

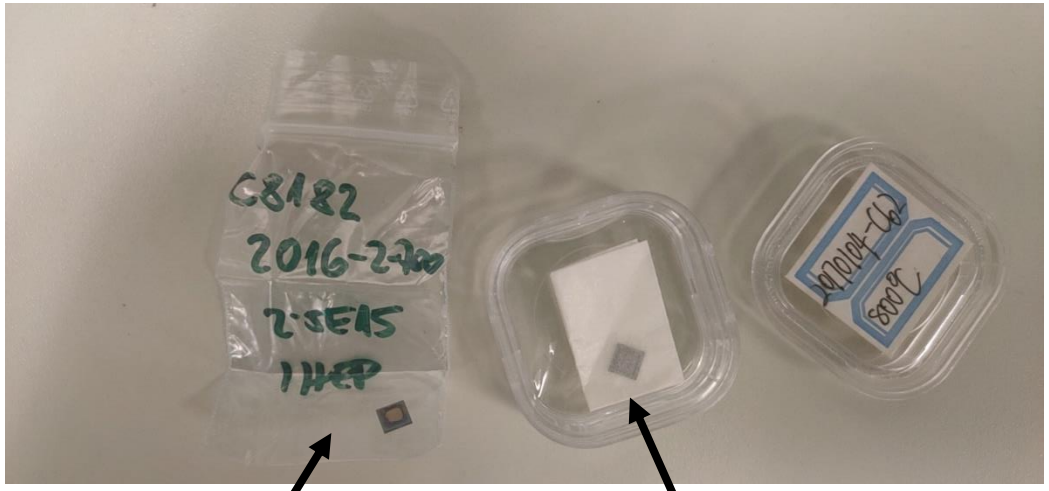
capacitance-DLTS (C-DLTS)

- **Irradiated SiC diode DLTS test:**

I-DLTS temperature scan

1. Fresh SiC SBD





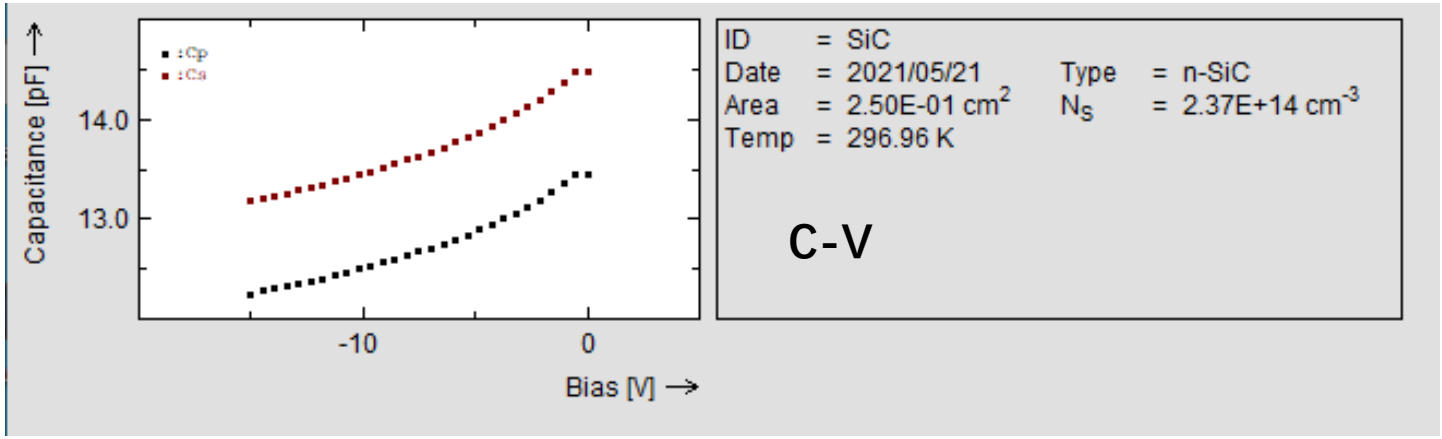
Irradiation Sample

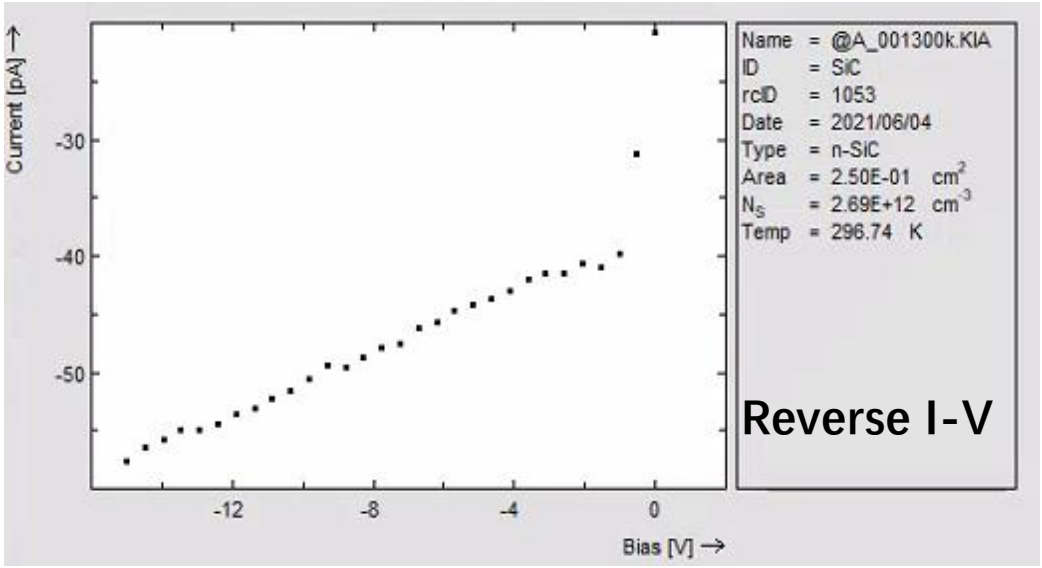
Fresh sample

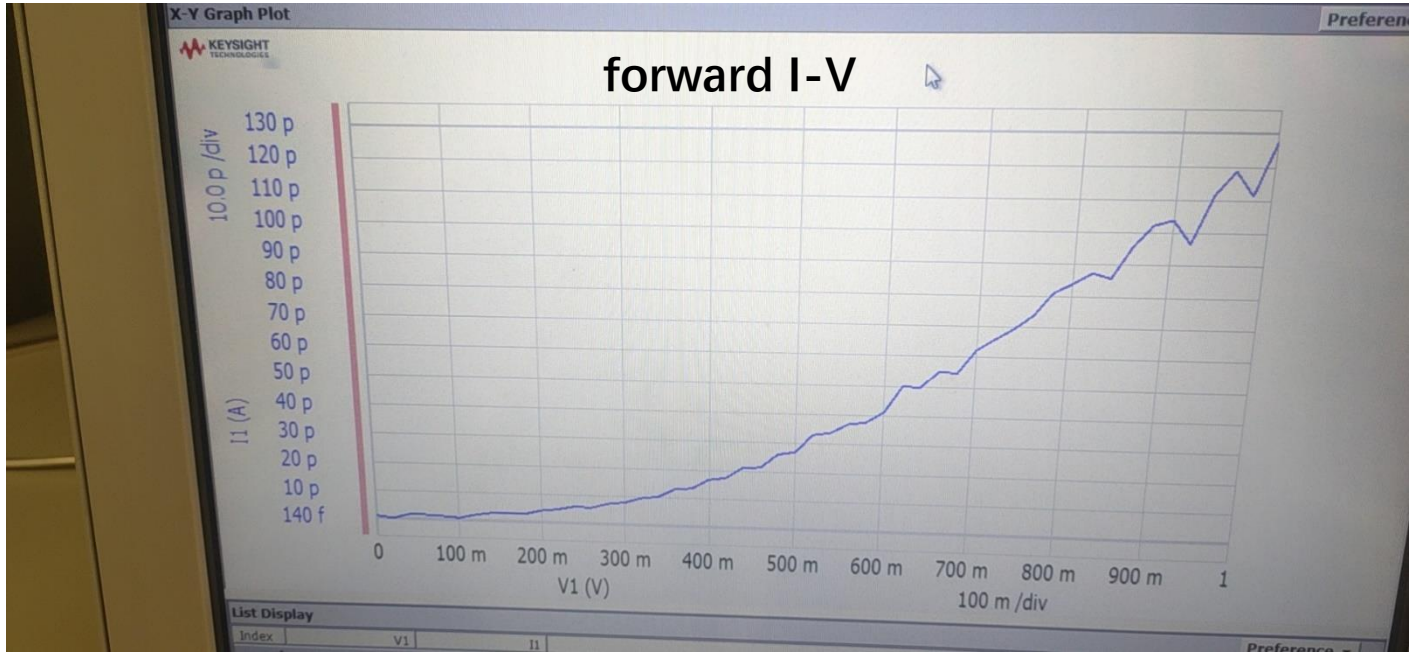
Sample Area：5mm x 5mm
Anode Area: 4mm x 4mm

Ns=1E14cm^{-3}

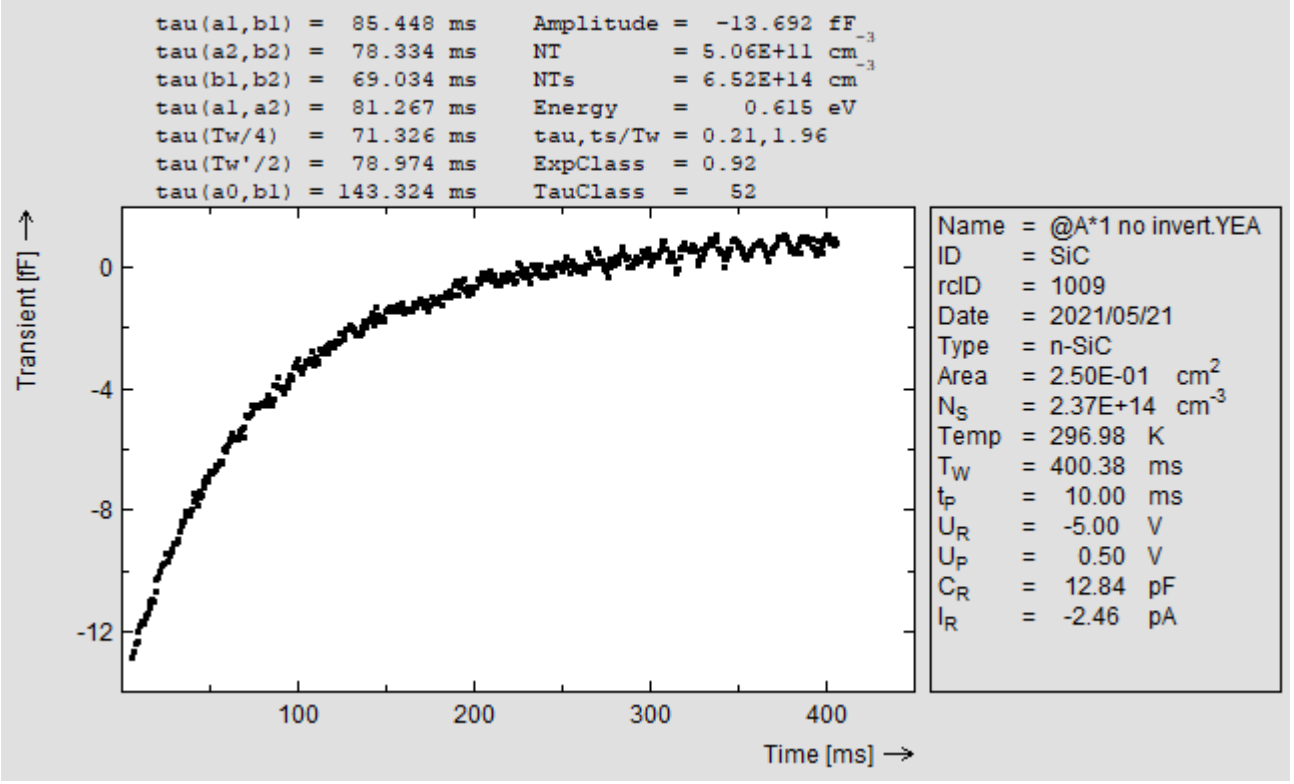
CV test for fresh SiC SBD at RT (300K)







Capacitance transient

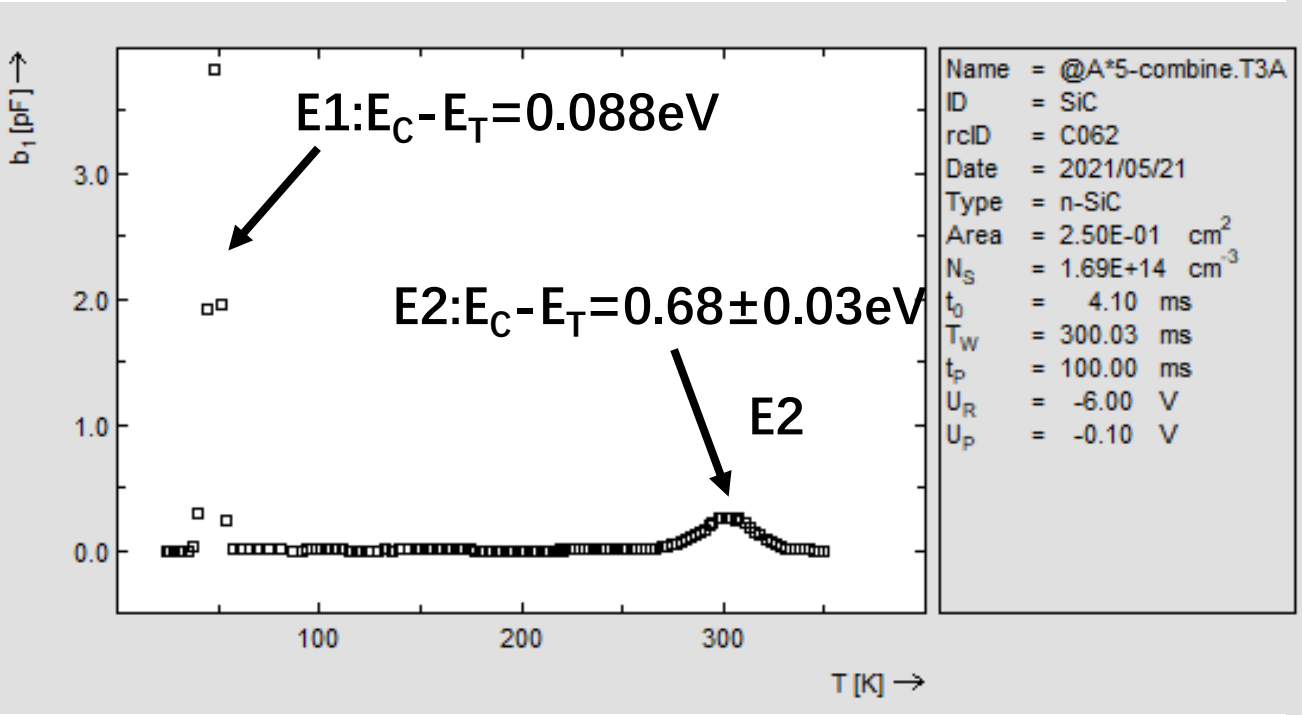


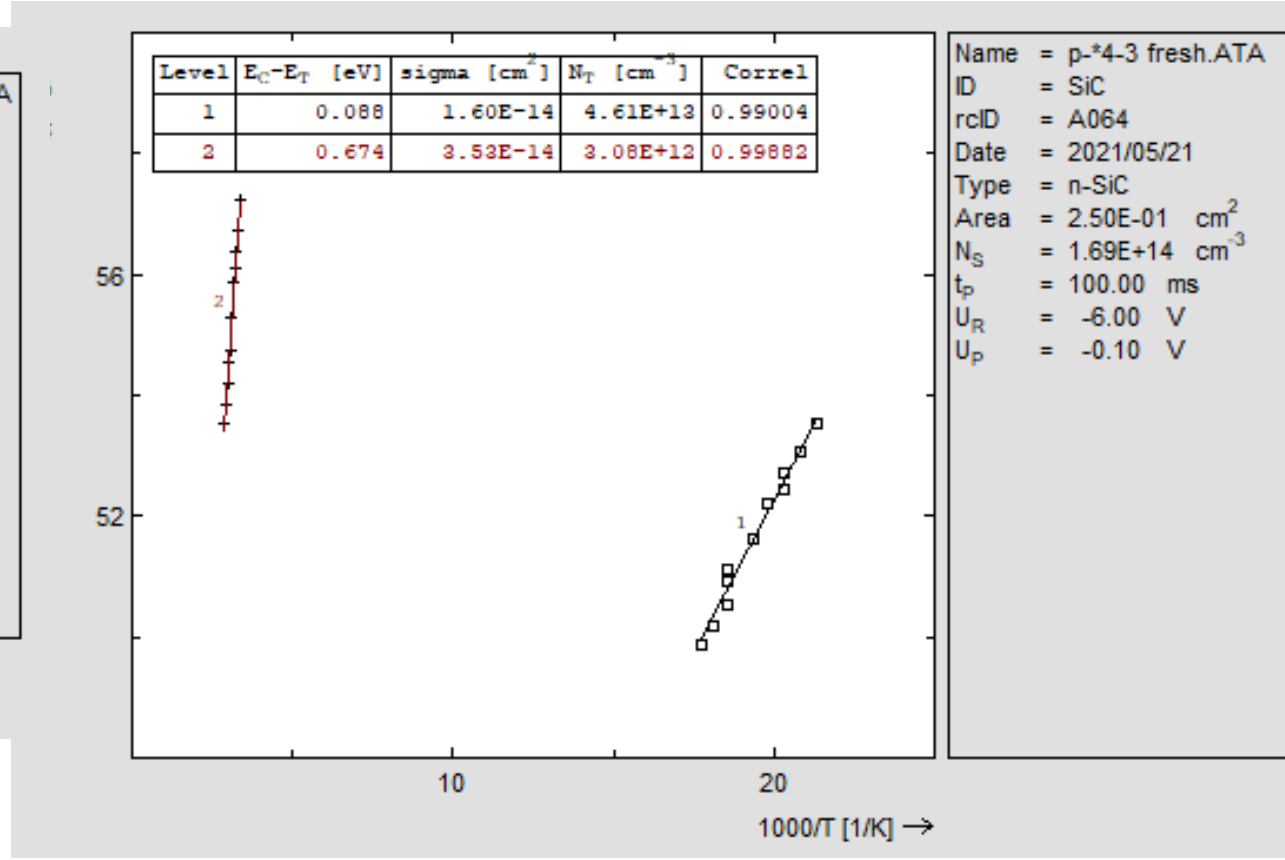
- Majority carrier trap

----electron trap

从瞬态趋势方向判断，fresh器件存在多数载流子陷阱

C-DLTS test of SiC fresh SBD （50-350K）





全温度范围变温测试C-DLTS：

- 发现两个电子陷阱，具有相似的俘获截面sigma(1E-14cm^2)
- 其中300K附近，发现E2陷阱在E_C-E_T=0.67eV，；
- 在50K附近测出能级较浅的E1陷阱，陷阱浓度也比E2高约一个量级

2. Irradiation SiC SBD

辐照条件：
1MeV的中子辐照
等效辐照计量为2.5e15 Neq/cm^2



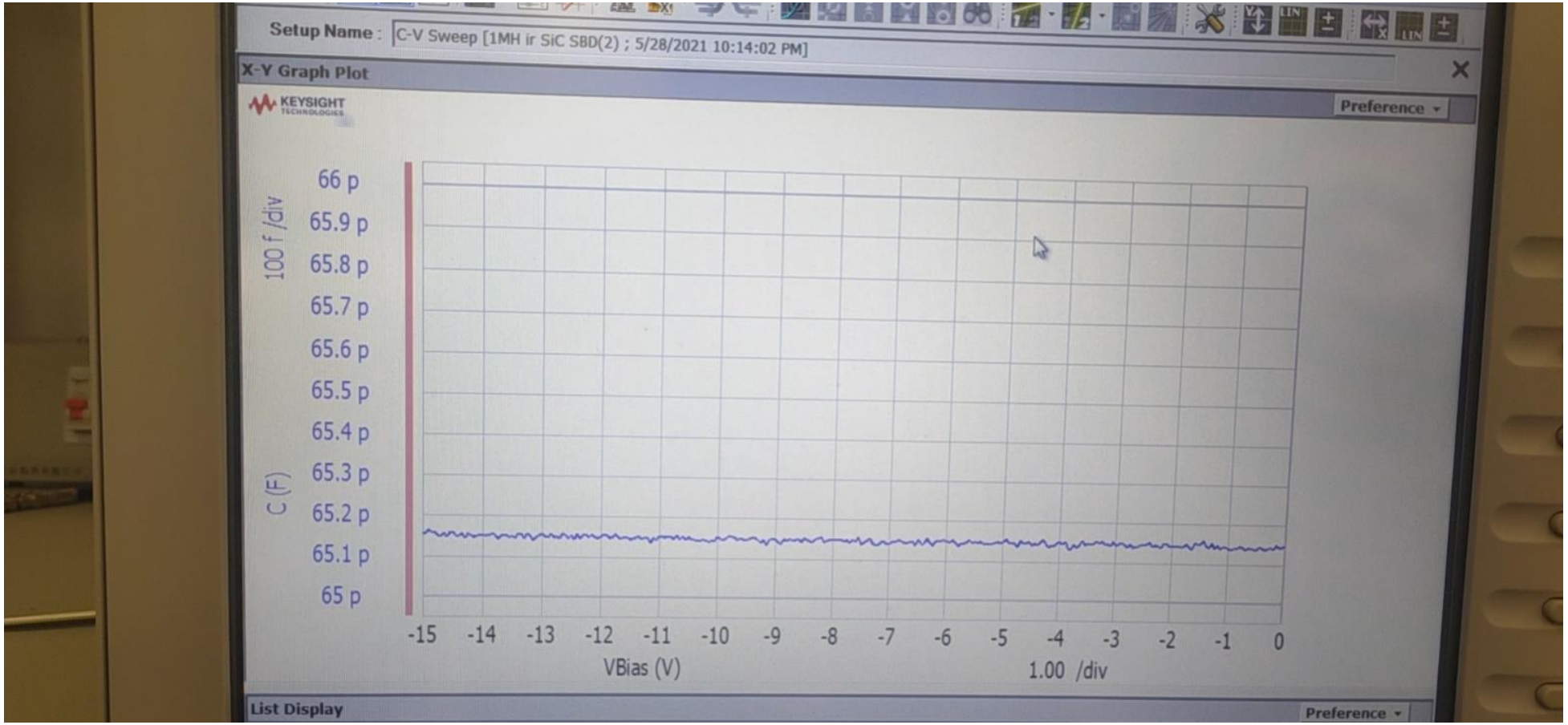


样品阳极



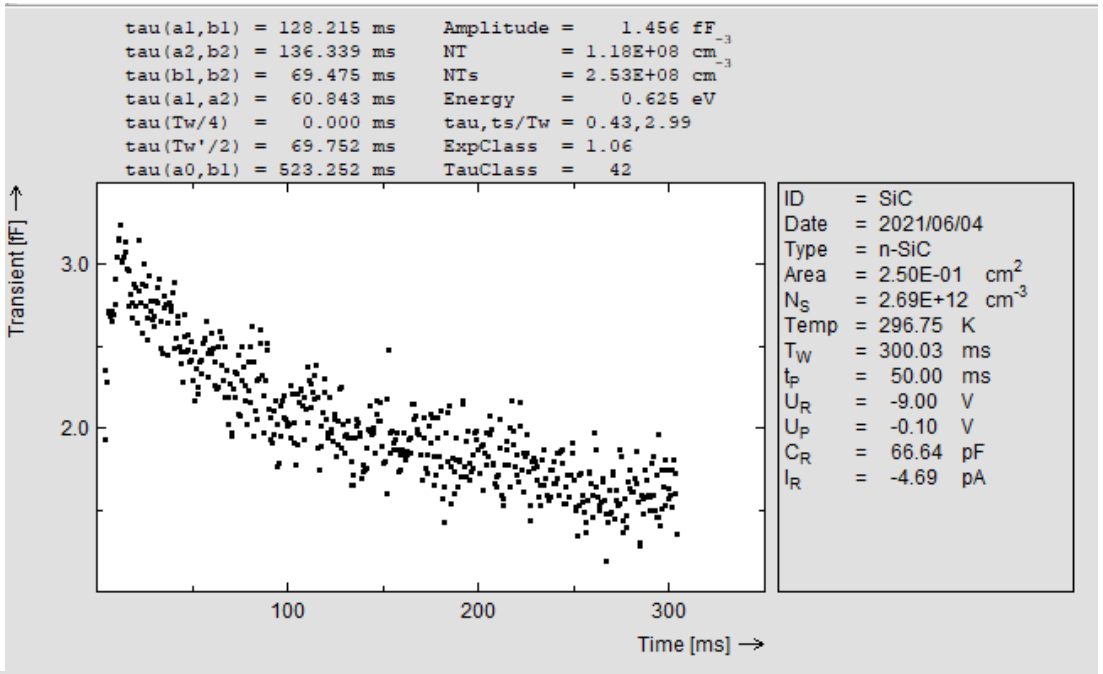
样品阴极

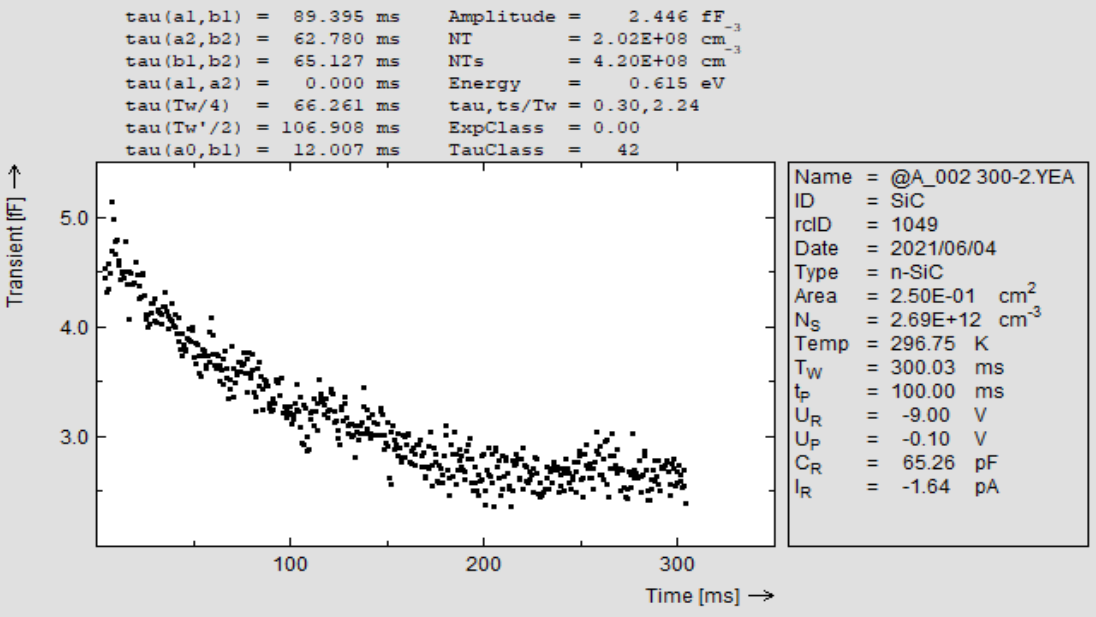
静态电学CV测试（300K）



辐照后样品，电容不随反向电压变化而变化，
近似一条直线。

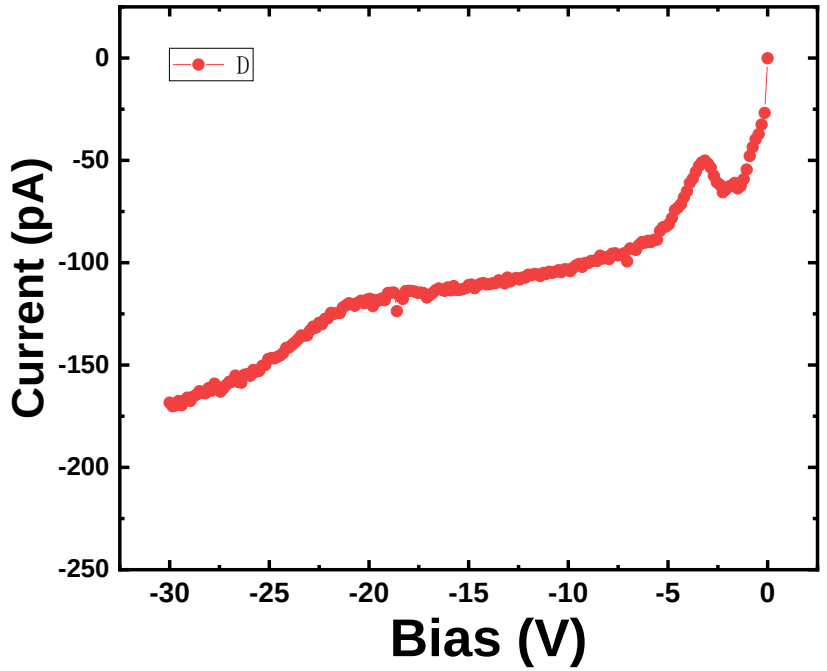
transient of irradiation SiC SBD





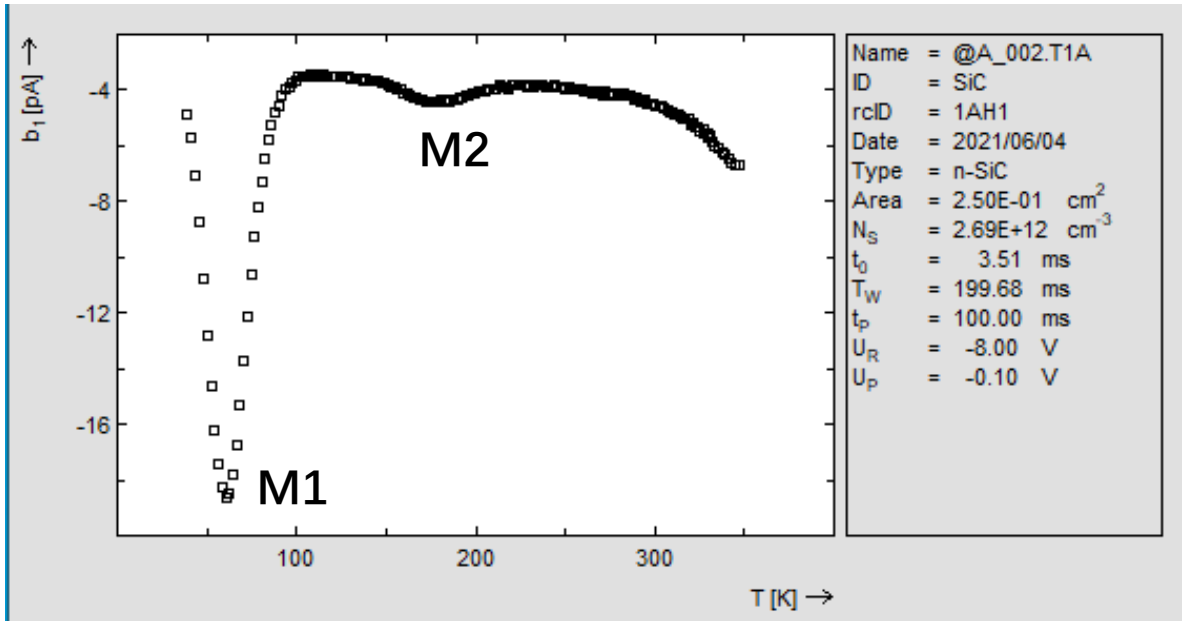
- 在常温下测试C-DLTS瞬态的变化方向，判断辐照后样品存在少数载流子陷阱，
- 但是电容瞬态幅度差值很小（小于3fF），电容瞬态的DLTS不再适合

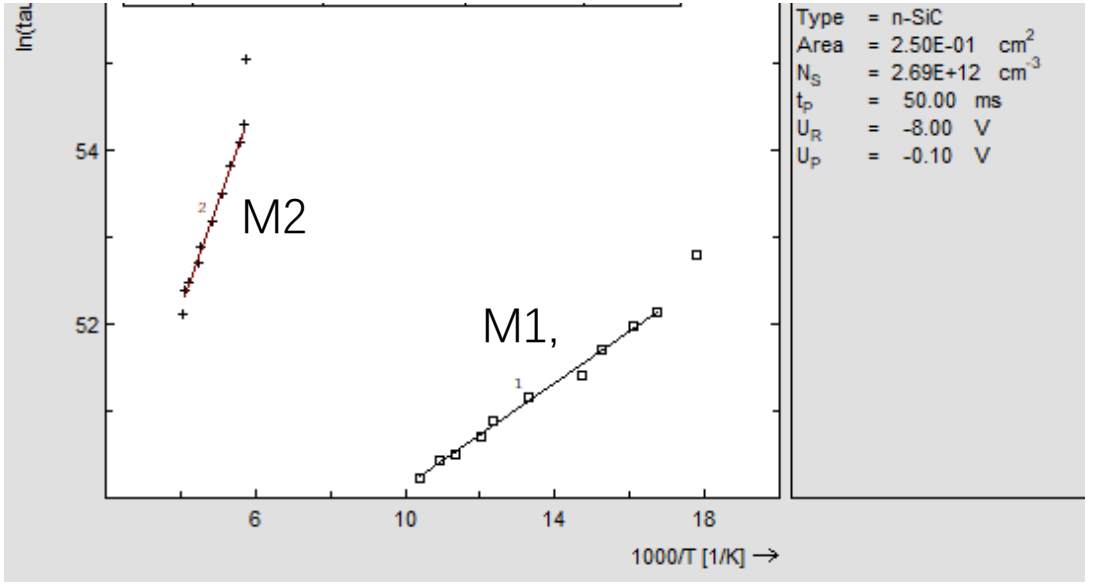
300K下 I-V静态特性



- 所以电容法的C-DLTS测试行不通，尝试采用电流法I-DLTS测试。

Irradiation SiC SBD I-DLTS test （20K-350K)

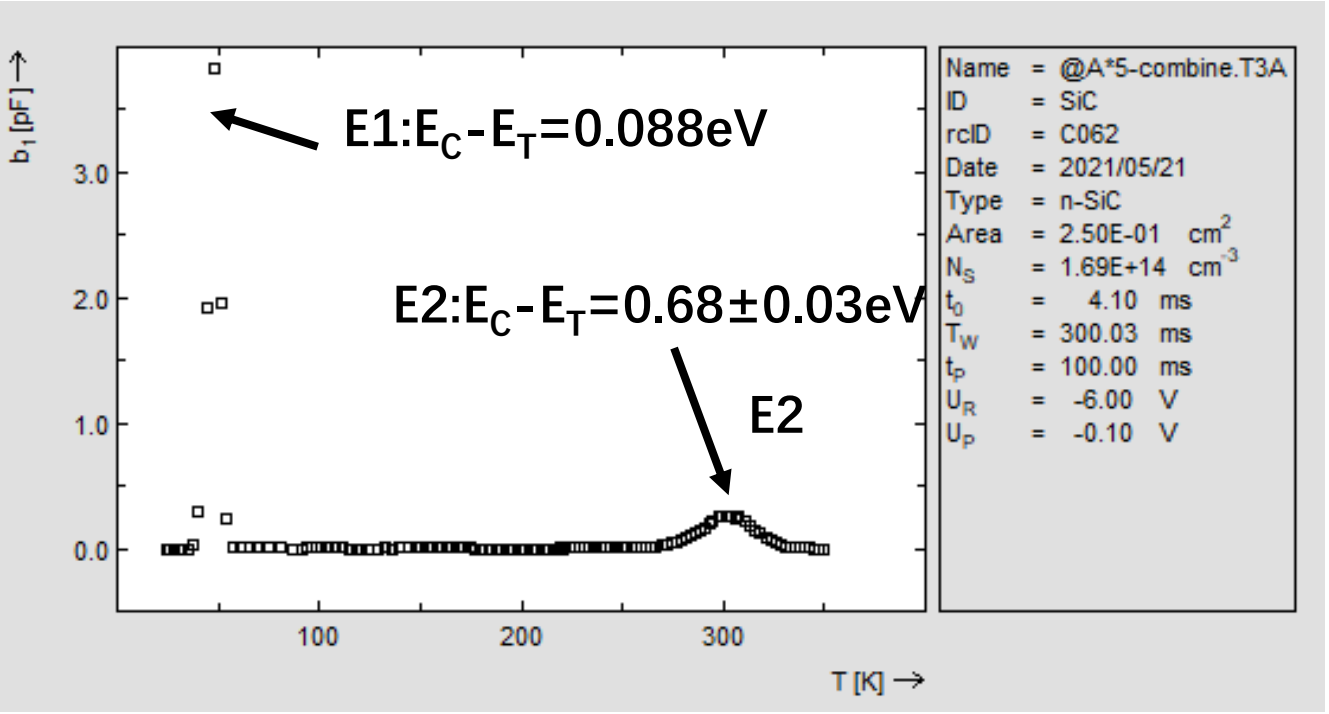


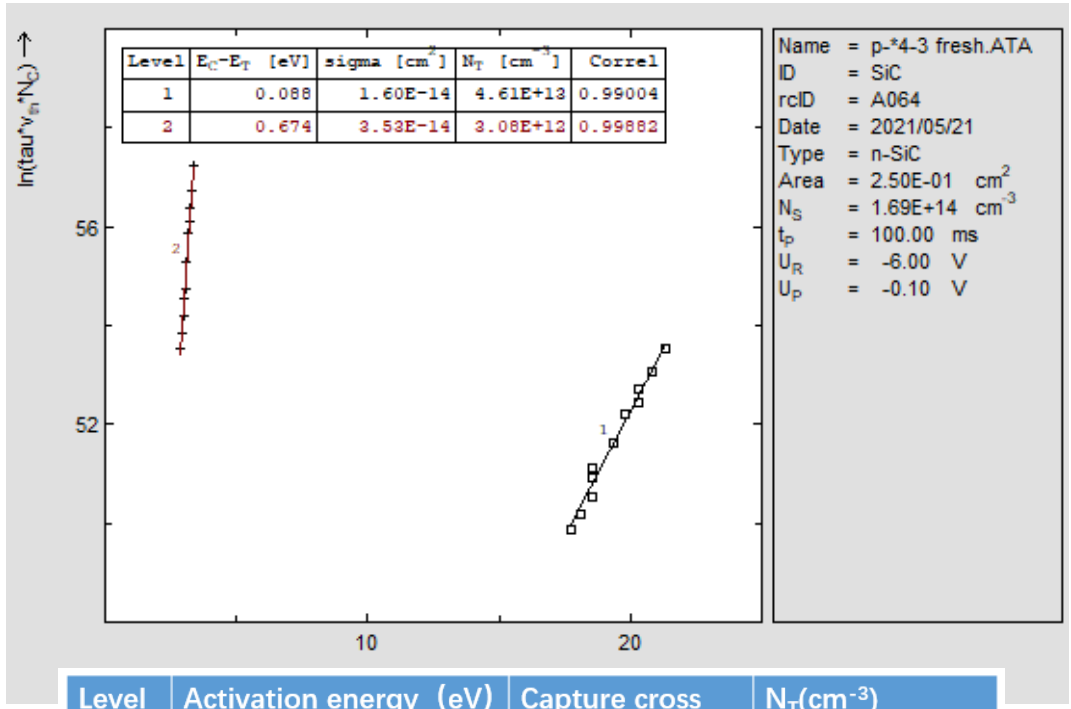


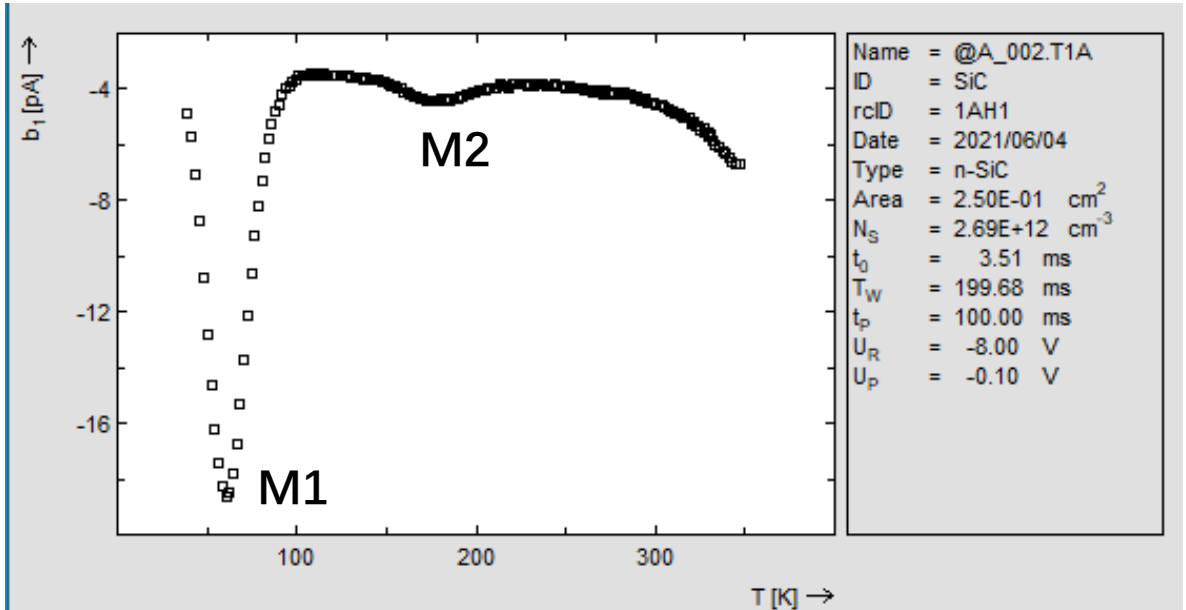
- 辐照后检测出2个少数载流子陷阱(M1,M2)

Level	Activation energy （eV)	Capture cross section (cm^2)	$N_T(cm^{-3})$
M1	0.026	3.36E-21	2.9E+10
M2	0.104	2.7E-21	6.65E+09

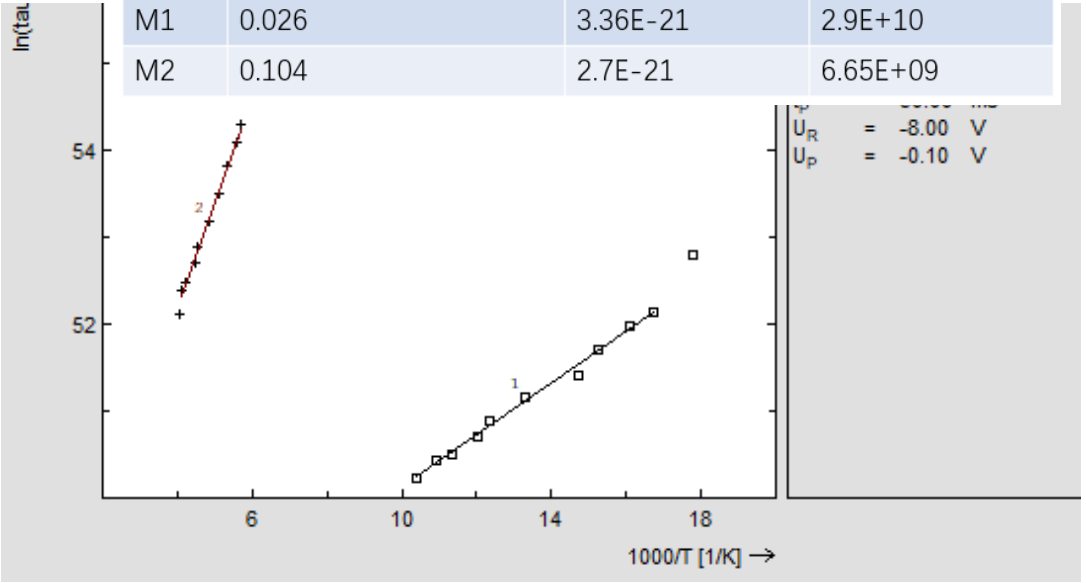
comparison







Level	Activation energy （eV）	Capture cross section (cm²)	N_T(cm⁻³)
M1	0.026	3.36E-21	2.9E+10
M2	0.104	2.7E-21	6.65E+09



总结：

- 对未辐照的样品，电容法C-DLTS在300K附近测出电子陷阱

E2(E_C-E_T=0.65eV), 低温下还测出了活化能为0.088eV的E1陷阱。

- 辐照后样品，由于电容不随电压有明显变化，因采用I-DLTS测试，发现了两个（空穴）陷阱.
- 辐照后样品测出的陷阱更浅，陷阱浓度都比未辐照小，表征俘获载流子能力的**俘获截面**也远小于未辐照样品。