L-shaped tunnel field-effect transistor (LTFET) has been experimentally reported to exhibit significant trap-assisted-tunneling (TAT) current [1]. However, its mechanism has not been investigated yet. This study investigates TAT mechanism using dynamic nonlocal Schenk model in Sentaurus. Sentaurus considers both lateral and vertical tunneling mechanisms and is the most accurate simulation tool for this study.

II. Trap-Assisted-Tunneling

Fig. 1(a) shows schematic of LTFET. TAT is caused by presence of interface trap states present at the interface between the gate dielectric and silicon channel. These states originates during the fabrication process and are highly dependent on fabrication process used.

III. Results

Dynamic nonlocal TAT model was used as well as Fermi statistics, and constant mobility model [2]. Fig. 2 shows band diagram in the 1D region in LTFET. Trap states are represented by black stars. Conduction/valence band Ec/Ev are represented by black/blue symbols, respectively. Fig. 2 shows that both thermal excitation and direct Ev to Et transitions are possible for some trap levels. Fig. 3 shows TAT rate GTAT contour plot. It shows that both lateral and vertical TAT are present.

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IV. Conclusion

Dynamic nonlocal TAT model was used as well as Fermi statistics, and constant mobility model [2]. Fig. 2 shows band diagram in the 1D region in LTFET. Trap states are represented by black stars. Conduction/valence band Ec/Ev are represented by black/blue symbols, respectively. Fig. 2 shows that both thermal excitation and direct Ev to Et transitions are possible for some trap levels. Fig. 2 shows TAT rate GTAT contour plot. It shows that both lateral and vertical TAT are present.

Fig. 2. Band diagram in 1D region of LTFET showing Ec/Ev (red and blue symbols, respectively) and Et (black stars). Thermal excitation and direct Ev to Et transitions are indicated by vertical and horizontal arrows, respectively. Et to Ec transition is a thermal event.

References