Recommended project list (get 20% additional credits)

1. 2D electrical field simulation of dual charge layers avalanche photodiodes[1].
   * 1. Review the area of avalanche photodiodes[2]
     2. Simulate the result of figure 1, 2, 3 in reference [1].
     3. Export the simulation results from the TCAD
     4. Analyze the simulation results
     5. Present the results
2. Simulation of the saturation performance uni-traveling-carrier (UTC) photodiodes
   * 1. Review the area of high power photodiodes[3]
     2. Simulate the result in Figure 2 (a), (b) and Figure 3 in reference[4].
     3. Simulate the optical frequency response of the photodiodes
     4. Analyze the simulation results
     5. Present the results
3. Optimizing the low operating voltage in a InGaAs biristor [5]
   * 1. Review the area of biristor
     2. Understand and model the content of the paper
     3. Repeat the results in Fig 3(b), Fig 4, and Fig 5.
     4. Present the results
4. Simulation of InAs/GaSb nBn detectors in reference [6]
   * 1. Review the area of InAs/GaSb type-II superlattice for mid-wavelength infrared applications.
     2. Understand and model the content of the paper
     3. Repeat the results in Fig. 3, Fig. 4, and Fig. 5. It is noted that the content of Fig.2 can’t be simulated by Silvaco TCAD, you can direct use the results of Fig. 2 to finish your task.
5. Theoretical analysis of InGaAs/InAlAs avalanche photodiodes [7, 8]
   * 1. Review the area of avalanche photodiodes
     2. Understand and model the content of the paper
     3. Repeat the results.
     4. Present the results
6. Elimination of Current Blocking in Ternary InAlAs-InGaAs-InAlAs Double Heterojunction Bipolar Transistors[9]
   * 1. Review the area of HBT
     2. Model the content of the paper and compare with experimental results in the paper with TCAD.
     3. Present the results

Reference:

[1] Y.-H. Chen *et al.*, "Top-Illuminated In0. 52Al0. 48As-Based Avalanche Photodiode With Dual Charge Layers for High-Speed and Low Dark Current Performances," *IEEE Journal of Selected Topics in Quantum Electronics,* vol. 24, no. 2, pp. 1-8, 2018.

[2] J. C. Campbell, "Recent Advances in Avalanche Photodiodes," *Journal of Lightwave Technology,* vol. 34, no. 2, pp. 278-285, 2016.

[3] T. Nagatsuma and H. Ito, *High-power RF uni-traveling-carrier photodiodes (UTC-PDs) and their applications*. INTECH Open Access Publisher, 2011.

[4] Z. Li, H. Pan, H. Chen, A. Beling, and J. C. Campbell, "High-saturation-current modified uni-traveling-carrier photodiode with cliff layer," *IEEE Journal of Quantum Electronics,* vol. 46, no. 5, pp. 626-632, 2010.

[5] W.-K. Kim *et al.*, "Vertical InGaAs Biristor for Sub-1 V Operation," *IEEE Electron Device Letters,* vol. 42, no. 5, pp. 681-683, 2021, doi: 10.1109/led.2021.3070334.

[6] Q. Yuan *et al.*, "High-Performance Midwave Type-II Superlattice Infrared Photodetectors With a Stepped InAs/GaSb Absorber," *IEEE Transactions on Electron Devices,* pp. 1-5, 2023, doi: 10.1109/TED.2023.3256965.

[7] S. Cao *et al.*, "Theoretical Analysis of InGaAs/InAlAs Single-Photon Avalanche Photodiodes," *Nanoscale research letters,* vol. 14, no. 1, p. 3, 2019.

[8] S. Cao *et al.*, "Theoretical studies on InGaAs/InAlAs SAGCM avalanche photodiodes," *Nanoscale research letters,* vol. 13, no. 1, p. 158, 2018.

[9] M. Mohiuddin, T. Tauqeer, J. Sexton, R. Knight, and M. Missous, "Elimination of current blocking in ternary InAlAs-InGaAs-InAlAs double heterojunction bipolar transistors," *IEEE transactions on electron devices,* vol. 57, no. 12, pp. 3340-3347, 2010.