Modeling current flow in nanoparticle doped polymer film systems

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Results: Non-Constant Potential

- When the duration of the non-constant potential phase lasted half time for \( T_{\text{total}} = 1 \), we saw that the current did not return to zero with the potential (figure 3).
- When the duration of non-constant potential was restricted to one tenth of the time \( T_{\text{total}} = 10 \), the current exhibits an oscillatory behavior without damping (figure 4).

Results: Constant Potential Varying Lead Lengths

- To simulate the infinite lead limit, we considered the impact of the length of the electrode leads.
- For a constant potential, the current should also remain constant, following Ohm’s law.
- However, we see that our model predicts a non-constant current flow.
- To isolate the cause, we examine the effect of the leads has on the oscillations.
- The lead length has no noticeable impact on the current flow on the time scale we considered (figure 5).

Results: Flat Potentials

- Plotted current for different constant potentials to investigate the impact of the potential.
- To determine if the oscillations are arising from setting the potential too high.
- We consider a variety of constant potentials varying from \( V = 0.00001 \) to \( V = 0.1 \).
- The potential has no effect on the time scale we examine in the system (figure 6).

Conclusions

- Our results are preliminary without structure change.
- Size of the leads and current values below \( V = 0.1 \) has no effect on the current behavior in our model, with both exhibiting similar oscillatory behavior.
- Next step is verifying our data with linear response by comparing to a model that treats complex current junctions as a scattering problem utilizing the Landauer method as seen in Wu et al. [4].

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References