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Peer Review

Review of: "Negative Capacitance Effect at the Interface Between Si Wafers with Undulating Surfaces"

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I find the manuscript's exploration of negative capacitance (NC) at the interface of Si wafers with undulating surfaces fascinating and innovative. I appreciate how it introduces a two-resistor structure where tunneling currents in vacuum areas drive NC, contrasting with positive capacitance from contact regions. The experimental setup impresses me with its systematic use of impedance analysis across varying distances, DC biases, and AC amplitudes, and I think the supporting figures like SEM images and frequency plots effectively illustrate the findings. I'm particularly drawn to the theoretical link between differential resistance and capacitance transitions, and I see great potential in the idea of inductor-less circuits. That said, I'd like to see a clearer explanation of how tunneling current results in negative dQ/dV, and I think adding a detailed circuit model with a derivation would strengthen the theoretical backbone.

From my perspective, the experiments are solid, but I'd love more precision on distance control; quantifying d would help, and some validation of the contact area assumptions. I also think the data analysis could dig deeper into frequency thresholds and resonance peaks, and I'd suggest annotating figures more clearly, like specifying colour bar values. I find the interpretation compelling, especially the tunneling current's role, but I'd feel more confident with direct measurements of it and a quick calculation of equivalent inductance to tie it to real-world applications. I noticed a few writing hiccups, undefined terms, and typos. Terms like "volatile capacitance" and "two-resistor structure" are central to the narrative but may confuse readers unfamiliar with the context. Defining these early would improve accessibility. Furthermore, minor issues include "allallal" (p. 1), missing units for d in figure captions, and inconsistent reference formatting (e.g., missing superscripts in the text for refs 4–7).

Overall, I believe this manuscript has a strong foundation and could make a real splash in device physics and engineering. I'd recommend sharpening the theory, beefing up experimental details, and refining

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the data presentation to maximize its impact. I'm excited about its potential and think that with these tweaks, it'll resonate even more with a wide audience.

Declarations

Potential competing interests: No potential competing interests to declare.

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