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Peer Review

Review of: "Angular-Controlled GST Phase-Change Double Micro-Ring Resonator for High-Speed Activation Functions in Neuromorphic Computing"

Qusay Raghib Ali Al-Taai[1]

1. University of Glasgow, Glasgow, United Kingdom

The paper presents a novel angle-controlled GST-based micro-resonator to improve nonlinear activation functions for neuromorphic computing. The concept of angled GST segments to tune the optical transmission properties is an interesting and innovative approach. The numerical modelling is comprehensive, and the study systematically investigates multiple phase configurations. The potential applications in neuromorphic photonics are promising. However, it has several critical limitations that need to be addressed before it can be considered for further academic publication. While the theoretical framework and simulations are well implemented, the lack of experimental verification significantly weakens the claims. In addition, there is not sufficient comparison with previous works; clearly, there is no detailed discussion of power consumption, which is very important in neuromorphic computing studies, and uncertainties about the stability and endurance of GST remain unaddressed. Improvements in these areas would significantly enhance the impact of this work.

One of the novelties in this paper, the concept of angular positioning of GST within the ring resonators, provides a new degree of control over optical transmission characteristics. Therefore, the dual-ring resonator design is an improvement over single-ring designs, allowing independent tuning of spectral selectivity and switching contrast.

In any neuromorphic photonic computing, the important key that should be included is energy efficiency, so discussing it will enhance the overall paper.

Here are some suggestions to be added:

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- Power dissipation in GST switching.

- Total power consumption per switching cycle compared to electronic neuromorphic photonic systems.

- Thermal management strategies to mitigate heat buildup.

Also, the study identifies 90° GST positioning in the first ring and 180° in the second ring as optimal but does not give a strong theoretical justification for why this configuration is superior. It is important to include a physical explanation about that.

Regarding the writing and clarity issues:

- The introduction is too long and repetitive, particularly in describing neuromorphic computing.

- Some sections lack focus, and figures are sometimes referenced without detailed explanations.

- The notation in the equations is inconsistent, making some parts harder to follow.

So, I recommend simplifying the introduction and ensuring figures are clearly described in relation to key findings.

Conclusion:

The paper presents a promising concept for tunable GST-based phase-change photonic devices that can contribute significantly to neuromorphic computing. However, the lack of experimental validation, insufficient performance benchmarking, and lack of addressing material limitations weaken its claims.

Final Recommendation:

Another revision is required before publication; the authors should:

- Provide experimental evidence of key claims if possible.

- Try to compare the performance metrics with similar works.

- Address GST stability issues and potential alternatives.

- Including a power efficiency analysis is important.

- Clarify why specific angular configurations are optimal.

- Improve writing and clarity to enhance understanding.

With these improvements, the paper could contribute to neuromorphic photonics research. If possible, I encourage the authors to conduct further experimental work and strengthen their theoretical justifications before resubmitting.

Declarations

Potential competing interests: No potential competing interests to declare.