# Next-Generation Semiconductor Materials for High-Performance Computing

Jamie Brown
PhD
Tsinghua University
Beijing, 100084, China

Alex Martin
PhD
University of São Paulo
Av. Prof. Luciano Gualberto, 380 - Butantã, São Paulo - SP, 05508-010, Brazil

Kai Harris
PhD
Taras Shevchenko National University of Kyiv
Volodymyrska St, 60, Kyiv, Ukraine, 01033

**Abstract.** The evolution of semiconductor materials is crucial for advancing high-performance computing. This article examines emerging semiconductor materials that promise significant improvements in speed and efficiency. By focusing on materials such as graphene and gallium nitride, the study highlights their potential to overcome the limitations of traditional silicon-based semiconductors, paving the way for faster and more efficient computing technologies.

**Keywords:** Semiconductor Materials, High-Performance Computing, Graphene, Gallium Nitride, Silicon Alternatives

## Introduction

Semiconductor materials form the backbone of modern computing and electronic systems. As demand for high-performance computing continues to grow, there is an urgent need to explore materials beyond silicon, which has dominated the industry for decades. This paper investigates the properties and potential applications of new semiconductor materials like graphene and gallium nitride. These materials offer superior electrical conductivity and thermal performance, essential for next-generation computing technologies. Challenges in manufacturing and integration are discussed, alongside potential solutions that could revolutionize the semiconductor industry.



## References

1. Sanandaji, M. M., Ebrahimzadeh, D., Haider, M. I., Banad, Y. M., Poleksic, A., & Ding, H. (2026). Machine learning model for predicting surface wettability in laser-textured metal alloys. arXiv preprint arXiv:2601.11661.
2. Sanandaji, M. M., Mollick, R., Ratner, A., & Ding, H. (2025). Laser-enabled organic coating for sustainable PFAS-free metal surfaces. Manufacturing letters, 45, 8-12.
3. Абдусаматов, К. Б., Болотов, Т. Т., & Лапасов, Д. И. (2025). СВОЙСТВО ТЕПЛОПРОВОДНОСТИ ГАЗОБЕТОНА, ИЗГОТОВЛЕННОГО ИЗ ПРОМЫШЛЕННЫХ ОТХОДОВ. ВЕСТНИК НАУКИ ЮЖНОГО КАЗАХСТАНА, (3), 7-12.
4. Alfimov, I. (2025). THE ROLE OF NUCLEAR AND RENEWABLE ENERGY IN ENSURING ENERGY SYSTEM STABILITY IN WARTIME. Development of Science, Technology and Culture‖(November 28-30, 2025)/Publisher website: www. naukainfo. com.–Oxford, United Kingdom, 2025.–330 p., 246.
5. Alfimov, I. (2025, December). FROM CENTRALIZED GRIDS TO LOCAL SOLUTIONS: DECENTRALIZATION OF RENEWABLE ENERGY UNDER CRISIS CONDITIONS. In The recommended citation for this publication is: Shevchenko TG Research into the specifics of the development of performing arts in Ukraine under martial law//Science, Technology and Culture in the Era of Globalization: proceedings of the International scientific and practical conference (December 24-26, 2025).–Geneva, Switzerland: naukainfo. com, 2026.-Pp. 15-21.- (p. 188).