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**A NEW ELECTRONICS REVOLUTION: IMPROVING THE EFFICIENCY AND OUTPUT OF POWER ELECTRONICS CIRCUITS WITH THE USE OF GALLIUM-NITRIDE TRANSISTORS**

The integrated circuit’s invention in 1958 was undoubtedly one of the most influential events of the twentieth century, allowing serious computing devices to be manufactured on a smaller and more affordable scale [1]. The integrated circuit was powered by the transistor, an electrical component made from silicon that, because of its properties as a semiconductor, could perform thousands of calculations per second [2]. Since its invention, transistors have become smaller and more powerful, allowing for an exponential increase in the processing power of integrated circuits.

However, innovation in silicon-based transistors is rapidly approaching its physical limit. The most recently developed transistors are seven nanometers wide, close to the size of an individual silicon atom [3]. Because there exists an insatiable desire for improved computing power in government, business, and academia, companies and research groups have turned to other materials through which the nature of the transistor can be redefined [3].

Researchers at the Massachusetts Institute of Technology (MIT) have recently perfected a compound called gallium-nitride for use in transistors [4]. Gallium-nitride has existed as a potential replacement for silicon for many years but lacked the full functionality of silicon in integrated circuits [5]. The MIT research team was able to alter the conventional process by which these transistors are made, therefore changing the resulting properties of the material [4]. These gallium-nitride transistors possess a fraction of the resistance of their silicon counterparts, allowing a more energy-efficient flow of electricity [6]. As it stands, gallium-nitride transistors present one of the most effective methods of replacing silicon transistors, launching a new era of innovation in electronics.

We will take a multifaceted approach to researching and evaluating the merits of gallium-nitride transistors. After explaining the motivation to find alternate materials for transistors, our paper will primarily focus on the compositional differences between the two types of transistors, including information about the respective processes by which each is created. We will then use this information to transition to a comparison between gallium-nitride transistors and silicon transistors, particularly emphasizing the difference in the conductivity of each material. Finally, we will show how these differences affect the construction and output of power electronics circuits andend by discussing the potential for gallium-nitride transistors to significantly impact the semiconductor industry.

We aim to consult a wide range of sources throughout our research on gallium-nitride transistors. We will find recent scholarly publications on the development of gallium-nitride transistors in order to understand the detailed processes by which our technology is created. For areas of knowledge that are foundational to our research, such as the role of the transistor in a circuit, we will use textbooks to help us convey information in a technical, yet comprehensible manner. When speaking about the reasoning behind innovating these transistors, as well as the current applications of gallium-nitride transistors, we will reference articles from companies at the forefront of the industry, such as Texas Instruments and Cambridge Electronics, Inc.

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**TOPIC AREA: CHEMICAL ENGINEERING**

We believe that the content of our paper is consistent with multiple topic areas of the conference, as is true with many areas of interest within engineering. Our paper most clearly fits into the realm of chemical engineering, as the elemental differences between transistors is the main focus of our research. However, we will take a comprehensive approach to supporting the main ideas of our topic, interjecting information from the field of electrical engineering to provide necessary context to the technical details of our research.