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WeARE Research Area

This research is based around the idea that there are better alternatives for semiconductor for power electronics other than the conventional Silicon, Silicon Carbide and Gallium Nitride, this material is Gallium Oxide that has been researched lightly and has shown the potential to be more efficient and more durable than the materials aforementioned.

Motivation or Background

The want to explore the field of power engineering and understand the materials that go into the electronics that are used in the field and the ways to make the industry more efficient and making it easier for us to advance in technology and make energy more cheaper and more accessible for everyone that needs it is one of the motivations for this research and should explain why there has been an increase in research in this topic that is relatively new to the world.

There has been little experience with power electronics and research, but have had family in the power industry before but in different discipline such as the power industry that is pertaining to oil and in different types of engineering like Mechanical and Chemical where they have passed down some knowledge of how the industry works but nothing relating to the electronics parts.

Objectives

1. The objective of this research is to find a better and more efficient material for the use in power electronics and other power applications than the already common ones such as Silicon Carbon and Gallium Nitride that are very popular in the transistors that are used today.
2. The other objective of this research is to find why this material is not being used more often and why there is little research on it and what are the difficulties that are involved with using this item in the electronics for today's appliances. The goal is find the pros and cons of this material to see if it's worth the replacement and if it's better than what we have right now.

Methodology

The method that was used to find the results for this research was to read articles that talked about the use of the new material and how it has been modified and how it compares to the other materials that are currently being used in the field and what were the disadvantages and the advantages that this materials brings up, It made sure that both sides were being brought up as the good and the bad have to be determined if it is a viable option for an alternative for the materials in transistors. The methodology involved comparing the efficiency and the Voltage and current of the transistor versus the ones that are currently being used in the electronics inside the field.

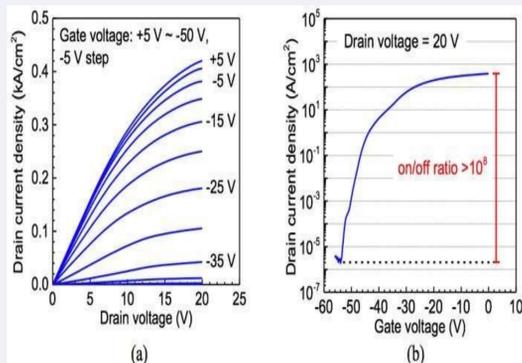


Fig. 1
 (A)DC Output (B) Characteristic of transfer in a vertical Ga203 MOSFET

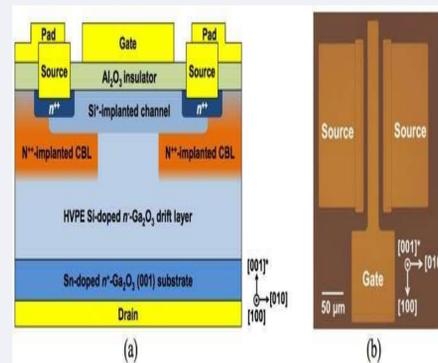


Fig. 2
 (A)Cross Sectional Schematic (B) Optical Micrograph

Results

The results of this research were the finding that while Gallium Oxide has shown to be more efficient at higher voltages and has the potential to reduce the heat if a diamond substrate is used in the transistor it has also been shown that it also has a lot of difficulties being used and molded into being a transistor and usable compared to the other. The pros of using this material over using other type of semiconductors is that, it is more efficient in higher voltages than Silicon Carbon and also Gallium Nitride, The other things is that it has higher amount of switching that helps reduce energy making it decently amount cheaper, one thing that makes it better for power electronics as they deal with high amount of voltage. This material also has a significant larger electric field strength than the other materials making it stronger and allowing it to be doped more heavily by more dominant doping profiles and allowing for flexibility, it is more than twenty times stronger than that of silicon and twice as strong Silicon Carbide and Gallium Nitride.

While this material has a lot of upsides it is still not very well known and also it is very hard to work with making it an undesirable choice currently. One Of the main cons of this material is that it does tend to get hotter quicker than others material and making it dangerous and at really high temperatures it is also less efficient. This problem can be solved if a diamond substrate is used the issue with that is that it would drive up the price making it less desirable compared to the other semiconductor that are being used in today's electronics. While it does have some downsides and it has been difficult to work with this material has shown the potential to be more beneficial if more research is done to it, because it has the ability to be more efficient and make it more desirable than the ones that are currently being used because it would in the longhaul be more cost effective and use less energy.

Skills and Experience

The skills that were needed for this research was the understanding of devices and materials and what happens inside a MOSFET and BJT transistor and how it relates to voltage and the magnetic field. Also requires basic knowledge of how this relates to power and how to determine what is useful when determining what is the best for Power electronics. I had only basic knowledge of materials and devices and almost none of power electronics as I have taken no class in that regards but only have experience from parents and articles that I have read.

What I Learned

The things that were learned in this experience is what is needed and wanted in a power appliance and what is desired in terms of voltages and what constitutes a good material for this kind of applications. I have also learned how what effects materials has on the appliances and the real life implications and what each material is capable of and how it is important for the right type of material to be used for the right stuff.

Future Plans

A future plan for this project is to be able to do simulation and be able to see how this material under more conditions and different voltages, so that the data gathered can be more useful because the articles at times has different numbers for different uses that make it inconsistent and make it harder to make to find the true benefits of this material over the other ones that are being used.

Acknowledgments

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