# Two-Dimensional Materials in Electronics


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***Abstract*—The following is a meta-analysis which delves into the field of two-dimensional (2D) materials within the realm of electronics. Key materials under scrutiny include graphene, molybdenum disulfide ($MoS_2$), and hexagonal boron nitride (hBN). This document and the research herein will then be used to generate an accompanying presentation.**



***Index Terms*—meta-analysis, two-dimensional materials, electronics**


## I. Introduction

## II. Graphene

### A. Material Structure

The atomic structure of graphene consists of a single layer of carbon atoms in the formation of a hexagonal lattice. This structure makes graphene one of the most promising materials within the realm of electronics, as it allows for exceptional electrical, mechanical, and thermal properties [1]. These properties contribute to graphene's high carrier mobility and physical strength, which has led to its integration into transistors, and, subsequently, touch screen and energy storage devices [2].

### B. Electromagnetic Properties

The structure of graphene permits remarkable electrical conductivity (several orders of magnitude higher than silicon), with a carrier mobility of $200,000\ [\mathrm{cm^2\,V^{-1}\,s}]$ at room temperature [**?**]. The electrons within the graphene exhibit Dirac fermion behavior, which is the primary reason for such mobility [**?**].

### C. Mechanical Properties

Due to the hexagonal lattice, graphene is ideal for electrical applications which require robust physical properties. The tensile strength of the material is approximately $130[\mathrm{GPa}]$ [**?**]; furthermore, graphene's flexibility makes it suitable for cases in which the device may experience stretching or warping [**?**].

### D. Thermal Properties

In addition to its electrical conductivity and physical strength, graphene holds a high thermal conductivity. At room temperature, graphene commands a thermal conductivity of approximately $5,300[\mathrm{W\,mK^{-1}}]$. As such, it may be used for thermal management [**?**].

### E. The Future of Graphene and Electrical Devices

Though the material itself is highly suitable for use within electronic devices, there are several challenges beyond aptitude which make the incorporation of graphene difficult. First and foremost is the difficulty of large-scale production. This, coupled with the difficulty of controlling the electrical properties and development of effect contact materials, make graphenes applicability within electronic materials uncertain [**?**].

## III. Hexagonal Boron Nitride (hBN)

## References

The following works were referenced within this meta-analysis.

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