Ty Davis
Dr. Justin Jackson
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Alternative Semiconductor Materials

The majority of the content of our ECE 3110 class has considered the use of silicon in semiconductor devices, but silicon is not the only semiconductor material available. Through the course of this paper I will consider the other types of semiconductor materials that are used commonly, how and why they're used, and their differences when compared with silicon. Semiconductor devices have changed the way our world works, and further developments are constantly being researched in an attempt to find devices that can do more for less energy used. The uses of semiconductor devices extend far beyond computation devices such as computer processors. The robust utility of semiconductors means that they've found their way into just about every electronic device we see today, and the magic behind a semiconductor lies in the fact they possess properties of both a conductor and an insulator.

The discovery of these electrical properties of semiconductors can be attributed to many people and began over 150 years ago. The very first instances of discovering semiconductor properties in materials can even date back to Faraday's observations regarding electrical conductivity in relation to temperature. This study dates back to the year 1833, but it would be a long time before people began thinking of semiconductors as such extremely useful devices. Another important discovery in the early development of semiconductor thought includes the experiment of Alexandre-Edmond Becquerel. When he experimented with the electrical properties of electrolytes, he one day "noted that, if one of the electrodes was illuminated with sunlight, the emf generated between the electrodes increased." (Jenkins). These first discoveries of semiconductor properties opened the gateway to many new ways to experiment with electricity. Doors were opened and discoveries began to poor in. Other important discoveries in the timeline of semiconductors include observations from Willoughby Smith and Heinrich Hertz, who had similar findings regarding photoconductivity in the late 1800s, and another late 1800s discovery regarding rectification in the contacts between metals and some oxides and sulfides. Discoveries like these poured out over the course of several decades and led to increased thought and innovation in the area.

Moving forward to the 1920s and '30s, there was a significant increase in demand for radar and other forms of communication due to the impending war. Under this pressure, and with the recent discovery of bipolar conduction in semiconductors (being the flow of current due to both electrons and holes moving), the scientific scene was ready for heavy increase in the development of semiconductor devices. The two primary material subjects of semiconductor research were silicon and germanium, though many materials possess the desired qualities in semiconductor behavior. Discoveries surrounding the p-n junction and its manufacture paved the way to new applications of diodes that could support more current flow. This eventually led to the discovery of transistors.

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