Who Gives A Sheet About Graphene?

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Graphene — a sheet of graphite that is one carbon atom thick — has been the subject of research efforts since the 1960s. With recent advances in synthesis methods, development of graphene-based inventions and the corresponding patent activity has intensified in the field.

But what makes graphene so different from other materials? And what is driving a level of patent activity that is so intense that it has been described as a "land-grab"[1]? More importantly, how do inventors of more recent graphene-based inventions make headway at the Patent Office in light of the trend? This article will first discuss the technological and commercial importance of graphene, and then outline strategies for patenting graphene-based inventions.

Technological and Commercial Implications of Graphene

Unlike most of technological advances of the past 20 years, graphene has the potential to revolutionize dozens of unrelated industries. The very unusual physical, chemical, electrical and optical properties of graphene are applicable to a dizzying array of technologies. Promising results have been shown for graphene in fuel cells, catalysts, optical displays and many other applications.

Graphene is easily adaptable to a variety of applications, which simplifies some aspects of product development. For example, graphene can be easily mixed with plastics, lending its incredible intra-sheet strength to a plastic matrix and making the combined material much stronger. Improving strength (and other properties including resistance to chemical or thermal degradation, conductivity, etc.) inspires both the creation of new products and the improvement of existing products.

Bulk graphene has also been tested as a catalyst for chemical reactions, improving reaction rates and yields far more than conventional transition metal catalysts. For example, graphene has been used in fuel cells to improve the efficiency of electricity production.

[1] http://www.materialstoday.com/blog/2013/1/25/the-best-thing-since-sliced-carbon-laurie-winkless/778.aspx

Graphene can not only be mixed in a bulk material, but can also be deposited as a thin film in the fabrication of electronics. These thin films can lead to new computer processors and faster, more efficient and smaller electronic devices.

The above list is a small sampling of the wide variety of graphene applications that have shown promising results. Undoubtedly, graphene has more exotic properties yet to be discovered. This is because the electrons within the two-dimensional structure of graphene are influenced by quantum mechanical effects. These effects create unusual electrical, conductive and optical properties that have yet to be fully appreciated, let alone applied commercially.

In short, graphene fits the materials engineering paradigm in which the structure of the material, its properties, and the methods used to process the material are all connected to each other. Because of this connection, changing one of these elements affects the other two. This complicates the study of the material, but it also enables a designer material to be crafted for a specific product or application by using each of the structure, properties, and processing intentionally. Graphene's adaptable form and unique properties make it a text book example for this paradigm, and a candidate for application to many different technologies.

Legal Complications in Patenting Graphene-Based Inventions

The intense patent activity in graphene stems from the enormous technological and commercial potential of graphene described above. The activity is analogous to "The Great Game" of the 19th Century, in which England and Russia vied to dominate the Middle East to control critical trade routes between Europe and Asia. Analogously, because graphene lies at the crossroads of dozens of distinct commercial and technological fields, inventors are vying to control the intellectual territory that will allow them to influence many of these distinct fields.

But because much of the territory underlying the graphene cross-roads has already been claimed, patenting graphene

poses challenges. Graphene, as a single sheet of carbon atoms (or an assembly a few sheets) has a relatively simple structure. This simple structure makes it more difficult to distinguish new inventions over inventions already described in patents or patent applications, many of which have very broad composition of matter claims.[2] In addition, the technology and legal background needed to understand and explain the uniqueness of a new graphene invention in the context of existing patents requires both specialization and breadth.

Strategies for Patenting New Inventions

There are two key elements to overcoming these two challenges: 1) an understanding of graphene technology; and 2) an understanding of the landscape of the technical field in which the new graphene invention lies. Understanding graphene technology enables the patent application and claims to be drafted clearly and strategically. For example, patent claims can be written with an appropriate scope so that already known aspects of graphene technology are avoided. The patent claims can also be written strategically with different fallback positions built in to provide options when negotiating with the Patent Office. This controlled retreat allows the patent scope to be narrowed slowly, preserving as much breadth to the invention as possible in light of the prior art.

Understanding the landscape in which the invention lies also helps the author of the patent application to appropriately frame the invention, highlighting the interesting aspects of the invention in light of the known art. This contrast between the new invention and the known art, written clearly and persuasively, helps to explain to a patent examiner the benefits of the invention. These contrasts and benefits can then be used to identify or explain unexpected results of the invention. Unexpected results can be used to great effect when negotiating with the Patent Office. In particular, identifying an unexpected result can trump a rejection by essentially capturing aspects of the inventiveness that are difficult to appreciate within the normal analysis performed by a patent examiner.

Understanding the technology and landscape can be fueled by some research on the part of the patent application author. With over eight million issued patents, the Patent Office file histories hold many lessons for the author of a patent application. Using a well-crafted search in the proper technology field, an author can identify new arguments, strategies, and patent prosecution techniques to incorporate into the application, and even creatively adapt arguments from different technologies. However, this must be done with thoughtfulness to avoid finding references that are relevant to the current invention, which must then be disclosed to the Patent Office.

Summary

Unlike the incremental advances of much of the past 20 years, graphene has the potential to revolutionize a wide variety of critical technologies, from energy production to communication equipment. Accordingly, inventors have been busy patenting intellectual property to control critical territory in the graphene field. To advance more recently filed patent applications, inventors of new graphene-based technologies should be aware of the landscape in which they are inventing, and incorporate creative arguments and strategic negotiating positions into their applications.

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[1] E.g., U.S. Patent No. 7071258; as a side note, these broadly claimed inventions also make it challenging for new inventions to be practiced without risking patent infringement.