
Patenting and Commercialization of Graphene Materials and Application Technologies: A Challenging Journey of 22 Years (2002-2024)

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Abstract

Dr. Jang has done some significant work in the graphene technology space as reflected by the following key technology milestones: (a) Dr. Jang's team filed world's first patent application on graphene as a new material in 2002 [1] and multiple patent applications in June and August 2004 [2,3]; (b) gave a technical presentation on electronic behavior of graphene at the American Physical Society annual meeting in 03/2004 [4]; (it may be respectfully noted that Drs. K. S. Novoselov and A. Geim published their truly remarkable paper in *Science* in October 2004 [5]); (c) established Angstrom Materials, Inc. (AMI) in 2007 and scaled up the production of graphene oxide in 2013; (d) invented the supercritical fluid exfoliation process in 2006 [6], liquid phase exfoliation (ultrasonication) process for graphene and other 2D materials in 2007 [7], and electrochemical exfoliation in 2007 [8]; and (e) invented graphene-based supercapacitors in 2006 [9], graphene-protected battery electrode materials (e.g., graphene-encapsulated Si) in 2007 [10], and graphene-based thermal films (thermal management materials) also in 2007 [11]. With this rich experience in graphene technology development and commercialization, Dr. Jang will offer some personal perspectives on the rapidly emerging graphene industry, emphasizing the opportunities and challenges in commercializing graphene materials and products. The technical and commercial challenges experienced by graphene producers will be high-lighted. The needs of graphene industry for truly cost-effective graphene production processes and commercially competitive products will be discussed in this presentation. Truly breakthrough graphene production and application technologies are essential to the emergence of an economically viable graphene industry. For instance, a significant challenge is the notion that graphene is a unique material that requires different processes to bring out the most desirable characteristics for a particular application. In other words, different processes are required to produce different types of graphene materials for different applications in different market sectors. There are also technical, economical, and regulatory issues that must be addressed in order for the large-scale production of affordable graphene materials to be fully realized. This will be followed by a discussion of some of the potential and realized applications of graphene materials, including thermal management, supercapacitors, batteries, and functional composites.

References

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