Applications of MoS_2 as a Two-Dimensional Material Beyond Graphene

Kraig Andrews*
Wayne State University Department of Physics and Astronomy
(Dated: March 23, 2015)

An article usually includes an abstract, a concise summary of the work covered at length in the main body of the article.

I. INTRODUCTION

The study of nanomaterials is wide-reaching and overlaps many different disciplines of scientific research, from physics to chemistry, materials science, and bio-medical engineering, for example. In the past decade research focusing on two-dimensional materials has rapidly increased compared to previous decades. This swift jump in the amount literature and studies being done on various two-dimensional materials is due to several breakthroughs which occurred in the mid 2000s, the resulting properties of such materials, and their possible and numerous applications which are many sweeping across a wide-range of disciplines both academic and commercial.

The major breakthrough that spurred the plethora of research and interest that now exists on two-dimensional materials and its uses was isolation of a mono-layer of graphene. In 2004 Geim et al. were able to isolate a graphene sheet for the first time [4, 5]. Graphite's existence had been known for several centuries prior and was applied in some mechanical settings [3]. However, it was not until 1985 and the discovery of fullerenes (C_{60}) that there was thought to be the possibility of interesting and beneficial properties of this structure and its subsequent derivatives, assuming that it could be synthesized in large quantities [2]. This discovery, albeit theoretical, led to further studies on various allotropes of carbon and suggested the existence of more structures, such as carbon nanotubes [1]. This previous research paved the way for the Geim et al. results which ultimately began the current boom of two-dimensional materials research. MoS_2

II. PROPERTIES OF GRAPHENE

[1] Sumio Iijima. Helical microtubules of graphitic carbon. *Nature*, 354:56–58, 1991.
[2] H. W. Kroto, J. R. Heath, S. C. O'Brien, R. F. Curl, and R. E. Smalley. C60: Buckminsterfullerene. *Nature*, 318:162–163, 1985.
[3] Ruben Mas-Balleste, Cristina Gomez-Navarro, Julio Gomez-Herrero, and Felix Zamora. 2d materials: to graphene and beyond. *Nanoscale*, 3:20–30, 2011.
[4] K. S. Novoselov, A. K. Geim, S. V. Morozov, D. Jiang, Y. Zhang, S. V. Dubonos, I. V. Grigorieva, and A. A. Firsov. Electric field effect in atomically thin carbon films. *Science*, 306(5696):666–669, 2004.
[5] K. S. Novoselov, D. Jiang, F. Schedin, T. J. Booth, V. V. Khotkevich, S. V. Morozov, and A. K. Geim. Two-dimensional atomic crystals. *Proceedings of the National Academy of Sciences of the United States of America*, 102(30):10451–10453, 2005.

* kraig.andrews@wayne.edu