Applications of MoS_2 as a Two-Dimensional Materials Beyond Graphene

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Overview

Search for new Materials

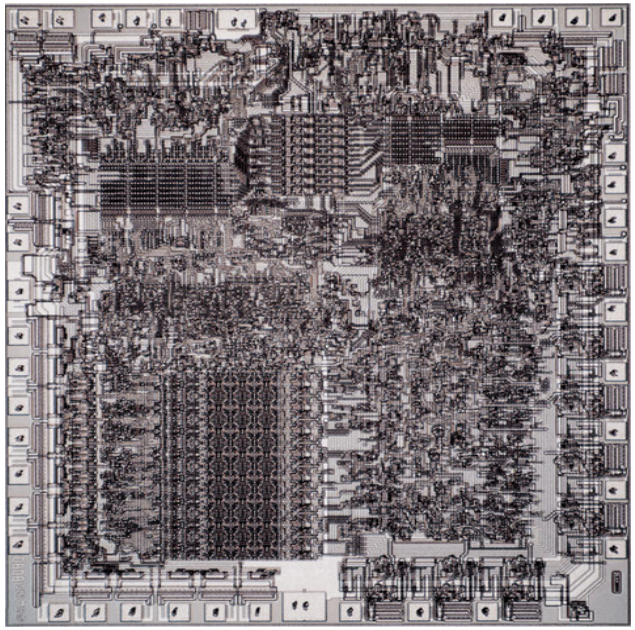

Figure: The Intel 8080 introduced in 1974 consisted of approximately 5,000 transistors

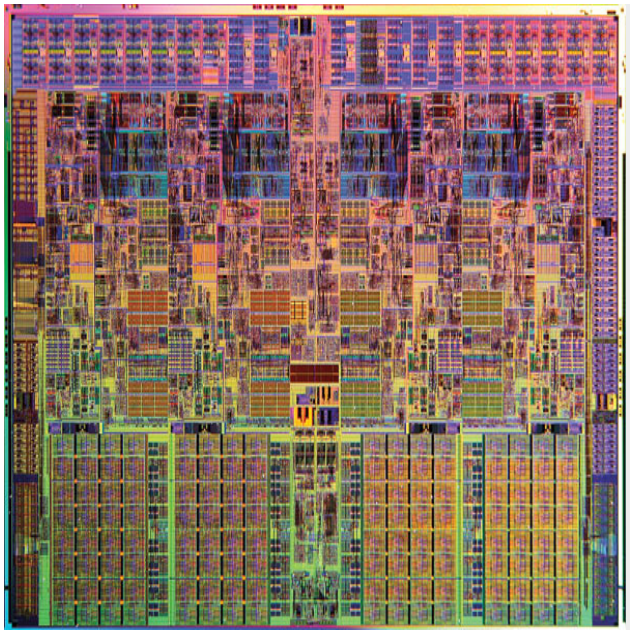

Figure: The Intel Core i7 in 2008 consisted of approximately 731 million transistors

[Grifantini, 2008]

Discovery of Graphene

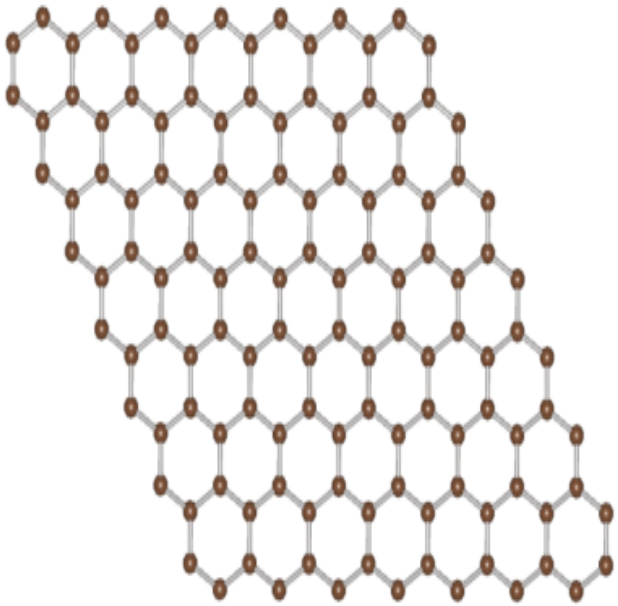

Figure: [Riken, 2012]

- Band Gap

Properties of Graphene

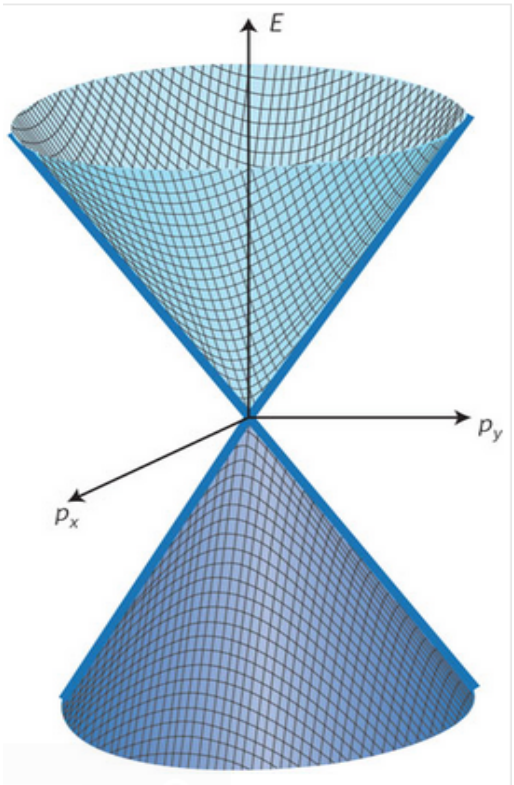

Figure: Electronic band structure of graphene [Fuhrer, 2010].

- Band Gap
- Mobility
- Young's Modulus

MoS_2

Transistion Metal Dichalcogenides (TMDs)

- Metal atom M
  - Mo, W, Nb, Re, Ni, or V
- 2 chalcogenide atoms X_2
  - S, Se, Te

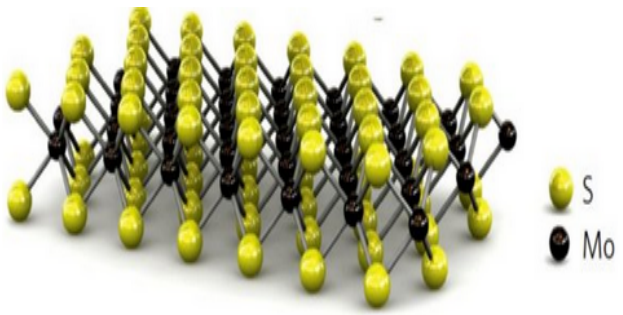

Figure: Bulk MoS_2 crystal [Wang, 2012].

Properties of MoS_2

Micromechanical Exfoliation of MoS_2

Figure: Bulk MoS_2 crystal [Wang, 2012].

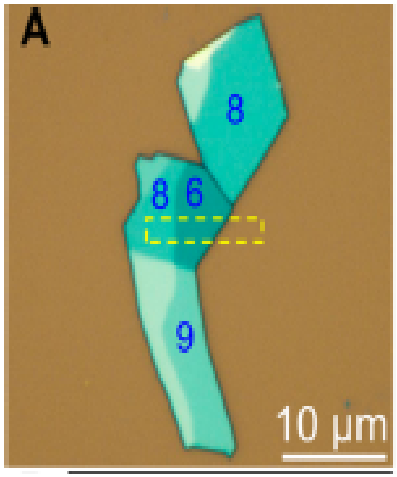

Figure: Image of MoS_2 [Li, 2014].

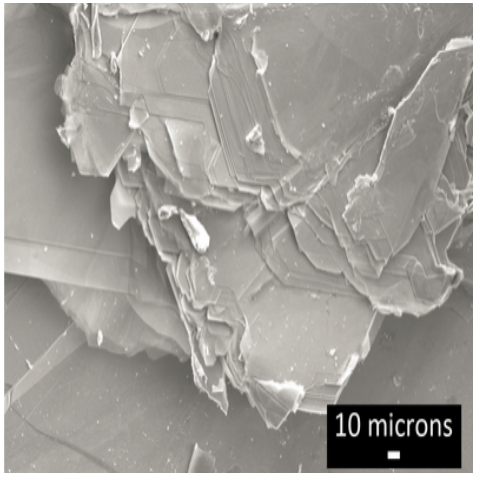

Figure: Example of layering in MoS_2 flakes [Radisavljevic, 2011].

MoS$_2$ in FETs

Figure: Bulk MoS$_2$ crystal [Wang, 2012].

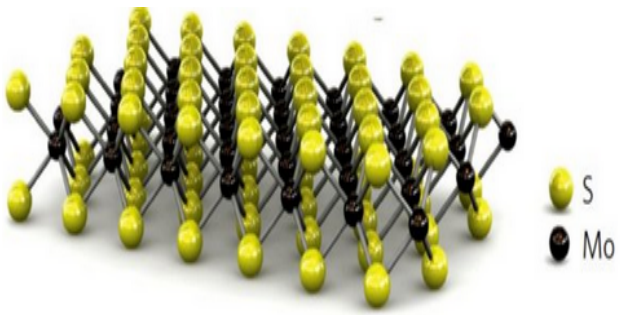

Figure: second figure

MoS_2 in FETs Continued

Outlook and Conclusion

References

Fuhrer, M.S. (2010)

Graphene: Ribbions piece-by-piece

Nature Materials (9), 611–612.

Grifantini, K. (2008)

Moore's Law

MIT Technology Review
http://www.technologyreview.com/photoessay/411485/moores-law/.

Riken (2012)

Successful Development of a Precision Graphene Production Control Method (Press Release)

Wang, Q.H. and Zadeh, K.K. and Kis, A. and Coleman, J.N. and Strano, M.S. (2012)

Electronics and optoelectronics of two-dimensional transition metal dichalcogenides

Nature Nanotechnology (7), 699–712.

References

Li, H. and Wu, J. and Yin, Z. and Zhang, H. (2014)

Preperation and applications of mechanically exfoliated single-layer and multilayer MoS$_2$ and WSe$_2$ nanosheets

Accounts of Chemical Research 47(4), 1067–1075.

Radisavljevic et al. (2011)

Single-Layer MoS$_2$ transistors

Nature Nanotechnology (6), 447–500