Graphene and 2D Materials

Group assignments for oral presentations

Course Outline

Course website:

http://www.physics.rutgers.edu/~eandrei/links.html#chengdu

Schedule

- Lectures :
  1. Monday July 9 (08:00 – 11:40)
  2. Tuesday July 10 (8:00 – 11:40)
  3. Wednesday July 11 (08:00 – 11:40)
- Oral presentations and written exam
  1. Friday July 13 (08:00 – 10:30)
  2. Written exam (10:45 – 12:00)

Course Structure

Oral presentations

- Each student is assigned to a work-group (4 or 5 students per group)
- Each group is assigned a topic to present in front of the entire class. The presentations should be done in English using projected powerpoint slides.
- Each group will have ~12minutes to present + 3 minutes for questions. Every group member is expected to speak for ~3 minute using no more than 2,3 slides. Alternatively you can chose one or two representatives who will give the entire presentation
- The group should search the literature to learn about their assigned topic using the on-line University resources. I have provided some references, but students are encouraged to find other articles on their own.
- The presentation files should be sent to the TA no later than

Thursday, July 12'th, 7pm

Final exam

The exam will cover material presented in the lectures and in the oral presentations.

Grade:

Oral presentation 50%, written exam 50%.

The oral presentation -example

Title
Group
Names of students

Outline
References

Graphene production by molecular beam epitaxy

Group 20

Ran Xuguang, Shi Yongheng, Song Tao, Tan Huaqiao, Ma Shiteng, Chen Junhong

1. Background (Ran Xuguang)
2. Principles of the MBE technique (Shi Yongheng)
3. Advantages of making graphene with MBE (Song Tao)
4. Challenges of MBE graphene (Ma Shiteng)
5. Reported results (Ma Shiteng)
6. Future prospects and applications (Chen Junhong)

References

- Tin S. Cheng et al, High temperature MBE of graphene on sapphire and hexagonal boron nitride flakes on sapphire , J. Vac. Sci. Technol. B 34, 02L101 (2016); http://dx.doi.org/10.1116/1.4938157
- Liquid exfoliation, graphene dispersions
- Nicolosi, N., Chhowalla, M., Kanatzidis, M. G., Strano, M. S. & Coleman, J. N. Liquid exfoliation of layered materials. Science 340, 1226419 (2013).
- J. N. Coleman, Liquid exfoliation of defect-free graphene, Acc. Chem. Res. 46, 14 (2013). doi:10.1021/ar300009f; pmid: 22433117
- Robert Petroa et al, Liquid Exfoliated Graphene: A Practical Method for Increasing Loading and Producing Thin Films, *ECS J. Solid State Sci. Technol. 2016 volume 5, 36-40* doi: 10.1149/2.0111602jss

Group 1: Two Dimensional crystals

Qinghao Li	李晴皓
Jianrui Li	李健睿
YongYu Zhang	张永渝
Wenhui Sha	沙文辉
Cheng Luo	罗晟

Suggested Reference:

1. Two-dimensional atomic crystals, Novoselov, K. S. *et al.* Proc. Natl Acad. Sci, 102, 10451–10453 (2005)

Group 2: Van der Waals heterostructures

Zijun Xu	许子俊
Mingyu Yuan	袁茗钰
Yubei Xiang	向昱蓓
Junhua Li	李君华
Bingqiang Liu	刘兵强

Suggested References:

1. *Van der Waals heterostructures, A.K. Geim and I. V. Grigorieva, 2013 Nature , **499** page 419*

Group 3: Graphene electronic structure

Deqi Tang	唐德奇
Yang Xu	徐洋
Yue Xie	谢岳
Zhiwen Zheng	郑志文
Ruyu He	何如彧

Suggested References:

1. *The rise of graphene, Geim A K and Novoselov K S, 2007 Nature Mater. **6** 18*
2. *Graphene: carbon in two dimensions, Katsnelson M I, 2007 Mater. Today **10** 20*
3. *Electric Field Effect in Atomically Thin Carbon Films*

Group 4: Klein tunneling and ballistic transport in graphene

Yuan Wei	魏源
Yunlong Mao	毛云龙
Shasha Bian	边沙沙
Siyin Dong	董思吟

Suggested References:

1. *Graphene: carbon in two dimensions, Katsnelson M I, 2007 Mater. Today **10** 20*
2. *Chiral tunnelling and the Klein paradox in graphene, Katsnelson M I et al, 2006,* Nature Physics 2, 620

Group 5: Mechanical properties of graphene

Jianghai Huang	黄江海
Xiang Li	李祥
Yinxin Li	李映昕
Rui Tao	陶锐

Suggested References:

Impermeable Atomic Membranes from Graphene Sheets, J. S. Bunch et al, Nano Lett., (2008) 8, 2458–2462

Electromechanical Resonators from Graphene Sheets, J. S. Bunch et al, Science (2007) 315, 490–493

Group 6: Graphene in magnetic field - Landau levels

Wenli Tian	田文丽
Hongfei Yu	于鸿飞
Ying Zhang	张英
Xueqi Zheng	郑学奇

Suggested References:

1. *Graphene: carbon in two dimensions, Katsnelson M I, 2007 Mater. Today **10** 20*
2. *The electronic properties of graphene, Castro Neto et al 2009 Rev. Mod. Phys. **81** 109*
3. Electronic properties of graphene: a perspective from scanning tunneling microscopy and magnetotransport, E.Y. Andrei et al, Rep. Prog. Phys. 75 (2012) 056501

Group 7: Quantum Hall effect in Graphene

Xuanpei Bai	白佩玄
Nian Cheng	陈念
Zhiying Deng	邓志颖
Zhenghui Fan	樊郑辉

Suggested References:

1. *The electronic properties of graphene, Castro Neto et al 2009 Rev. Mod. Phys.* ***81*** *109*
2. Electronic properties of graphene: a perspective from scanning tunneling microscopy and magnetotransport, E.Y. Andrei et al, Rep. Prog. Phys. 75 (2012) 056501
3. Two-dimensional gas of massless Dirac fermions in graphene Nature, K. S. Novoselov, et al 2005, 438, 197–200

Group 8: Techniques for making graphene – chemical vapor deposition

Shuaikang Fan	范帅康
Aoxiang Guo	郭翱翔
Youhong Hu	胡友宏
Cuiyue Liu	刘翠玥

Suggested References:

A review of chemical vapour deposition of graphene on copper , Mattevi C, et al, 2011 J. Mater. Chem. ***21*** *3324*

Group 9: Techniques for characterizing graphene – Scanning tunneling microscopy STM

Maomiao Song	宋茂彪
Yuting Xiang	向玉婷
Yuxing Xu	徐宇星
Haoquan Ye	叶昊泉

Suggested References:

1. Electronic properties of graphene: a perspective from scanning tunneling microscopy and magnetotransport, E.Y. Andrei et al, Rep. Prog. Phys. 75 (2012) 056501
2. Scanning tunneling microscopy and spectroscopy of graphene layers on graphite A. Luican, G. Li and E.Y. Andrei, Solid State Commun. 149, (2009), 1151

Group 10: Applications of graphene – Water filters, desalination

Zongkui Yi	易宗奎
Shuili Yue	岳水利
Xi Zhang	张晰
Dengchao Zheng	郑登超

Suggested References:

1. *Water desalination using nanoporous single-layer graphene, Surwade, S. P. et al., Nat. Nanotechnol. 10, 459–464 (2015)*
2. *Ultimate permeation across atomically thin porous graphene. Celebi, K. et al. Science 344, 289–292 (2014).*