The Research Grants Council of Hong Kong NSFC/RGC Joint Research Scheme Joint Completion Report

(Please attach a copy of the completion report submitted to the NSFC by the Mainland researcher)

Part A: The Project and Investigator(s)

1. Project Title

Interfacial Engineering of Graphene Heterostructures and Its Device Applications

	Hong Kong Team	Mainland Team
Name of Principal	Prof. XU Jian Bin	Prof. WANG Xinran
Investigator (with title)		
Post	Professor and Director,	Professor and Recipient of
	Recipient of Chang Jiang	Youth Thousand Talents
	Chair Professor	Scheme
Unit / Department /	Electronic Engineering Dept.	School of Electronic Science
Institution	& Materials Science and	and Engineering, Nanjing
	Technology Research Center,	University
	The Chinese University of Hong	
Contact Information	Kong Tel: (852) 3943 8297	Tel: (86) 25-83621502
Contact information	Email: jbxu@ee.cuhk.edu.hk	Email: xrwang@nju.edu.cn
Co-investigator(s)	Asso. Prof. MIAO Qian,	Prof. WANG Junzhuan,
(with title and	Chemistry Dept. and	School of Electronic Science
	Materials Science and	and Engineering/Nanjing
institution)		0 0 5 0
	Technology Research Center,	University
	Chinese University of Hong	
	Kong	

2. Investigator(s) and Academic Department/Units Involved

3. **Project Duration**

	Original	Revised	Date of RGC/
			Institution Approval
			(must be quoted)
Project Start date	Jan. 1, 2013		
Project Completion date	Dec. 31, 2016		

NSFC/RGC 8 (Revised 10/15)

Duration (in month)	48 months	
Deadline for Submission of Completion Report		

Part B: The Completion Report

5. Project Objectives

5.1 Objectives as per original application

- 1. To develop a novel growth technique to produce high quality graphene sheets applicable for heterostructures, as well as a viable transfer process for locating graphene sheets onto SiO₂/Si substrate modified by self-assembled monolayer (SAM), and boron nitride substrate.
- 2. To develop new strategies for fabrication of graphene heterostructures for high performance devices with a largely improved on/off ratio of current.
- 3. To investigate electronic and optoelectronic properties of graphene heterostructures modified by physisorbed or chemisorbed molecules as well as substrates.
- 4. To explore novel device architectures for high performance electronic and optoelectronic devices.
- 5. To have better understanding of the graphene growth, heterostructures, and device operation through theoretical calculations.
- 5.2 Revised Objectives: N. A.

Date of approval from the RGC: _____

Reasons for the change: _____

NSFC/RGC 8 (Revised 10/15)

6. Research Outcome

Major findings and research outcome *(maximum 1 page; please make reference to Part C where necessary)*

We have accomplished the following major research findings. The relevant details can also be found in Section 5.3.

- 1. Accomplishment of a unique graphene growth process and refinement of an existing transfer process. Several polycyclic aromatic hydrocarbon (PAH) precursors, namely, coronene, triphenylene, pentacene, rubrene etc., were used to prepare large-area graphene sheets. More details can be found in Refs. #J3, #J10, #J13, and #J26.
- 2. Finding scattering sources that hinder the carrier mobilities of graphene and MoS₂ on bare SiO₂/Si substrate and OTMS SAM modified SiO₂/Si substrate. More details can be found in Refs. #J3, #J10, #J13, and #J31. The analytical methods can be used for other 2D materials.
- 3. Attainment of a high carrier mobility in CVD synthesized graphene up to 1.00×10^4 cm²/V-s, along with a long mean free path, nearly vanished hysteretic behavior, and remarkably low intrinsic doping level. More details can be found in Refs. #J29, and #J31.
- 4. Advances in CVD synthesized WS₂-WSe₂ lateral heterstructures and electrochemical deposition of MoS₂. More details can be found in Refs. #J1, #J2, #J10, #J13, and #J15,
- 5. Advances in several new types of optoelectronic devices based graphene and other 2D semiconductor heterostructures. More details can be found in Refs. #J4, #J5, #J9, #J12, #J13, #J14, #J16, #J17, #J22, and #J30.
- 6. Development of new strategies for the weak epitaxial growth of organic semiconductors. More details can be found in Refs. #J7, #J8, #J11, and #J25.
- 7. Improved understanding of high-k gate dielectrics on carrier mobility of MoS₂ and graphene TFT. More details can be found in Refs. #J3, #J10, and #J13.
- 8. Development of new strategies for graphene lateral heterstructures. More details can be found in Refs. #J20, #J24, #J27, and #J28.
- 9. Theoretical investigations of the configuration-dependent properties of graphene monolayers and graphene nanoribbons, several carbon clusters on BN substrate, doping by metallic species on MoS₂ few layers, lateral phosphorene-graphene and phosphorene-WSe₂ heterostructures through DFT calculations. The relevant details can be found in Refs. J#6, J#18, J#19, J#21, and J#23.

Potential for further development of the research and the proposed course of action *(maximum half a page)*

- 1. SAM passivated SiO₂ and/or passivated Al₂O₃ on silicon substrate for graphene and other 2dimensional layered semiconductors will be very useful for exploration of electronic and optoelectronic properties and novel device configurations.
- 2. Hybrid device architectures composed of graphene and 2D layered semiconductors as well as photoactive substrates can be further interrogated for high-performance optoelectronic devices with ultrahigh sensitivity and ultra-broad spectral range.
- 3. 2D organic layered semiconductors are a new class of 2D layered materials worth further exploration.

7. The Layman's Summary

(describe *in layman's language* the nature, significance and value of the research project, in no more than 200 words)

Single atomically-thick graphene and two-dimensional layered transition-metal dichalcogenides (TMDCs, or simply denoted 2D layered materials) are of considerable scientific and technological significance, thanks to their novel properties and the potential in flexible electronics/optoelectronics, as well as nanoelectronics/nanophotonics. A fundamental understanding of electronic, compositional, structural, and optical properties of the

atomically-thin films is vital in many possible applications, including light emitting devices (LEDs), field effect transistors (FETs), RFID transceivers, biosensors and hybrid solar cells. This project has focused on the interface engineering of graphene heterostructures that are the key elements for large area, flexible, light-weight, and low-cost electronics. After the intensive studies in understanding the interface properties of FETs and optoelectronic devices based on 2D layered materials, we have successfully attained: 1. preparation of high quality CVD graphene in centimeter scale and MoS₂ in millimeter scale, respectively; 2. one of the best transistors among graphene field-effect transistors on SAM modified SiO₂/Si substrates at room temperature; 3. highly sensitive photodetectors from visible to the near-infrared and mid-infrared spectral range; 4. a new processing strategy for organic layered semiconductors in the near future development; 5. novel architecture design for optoelectronic devices; 6. a new strategy for improving the device stability based on 2D layered materials. The project has unequivocally manifested the success of the interdisciplinary research.

Part C: Research Output

8. Peer-reviewed journal publication(s) arising <u>directly</u> from this research project (Please attach a copy of each publication and/or the letter of acceptance if not yet submitted in the previous progress report(s). All listed publications must acknowledge RGC's funding support by quoting the specific grant reference.)

The	e Latest Status	of Publica	tions	Author(s)	Title and	Submitted to	Attached	Acknowledge	Accessible
Year of	Year of	Under	Under	(bold the	Journal/	RGC	to this	d the support	from the
publication	Acceptance	Review	Preparation	authors	Book	(indicate the	report (Yes	of this Joint	institutional
^	(For paper		-	belonging to	(with the	year ending	or No)	Research	repository
	accepted but		(optional)	the project	volume,	of the	-	Scheme	(Yes or No)
	not yet			teams and	pages and	relevant		(Yes or No)	
	published)			denote the	other	progress			
	· ·			corresponding	necessary	report)			
				author with an	publishing				
				asterisk*)	details				
					specified)				
#J1, 2017				K. Chen, X.		No	Yes	Yes	Yes
				Wan, J. B.	Stitching				http://aims
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				1 1u	Stacking				hk/converi
					Growth of				
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					(TMDCs)				
					Heterojunc				
					tions,				
					Advanced				
					Functional				
					Materials				
					27 ,				
					1603884				
					(2017)				

#J2, 2017	Cł	hen, J. B. u *, et al.	Controlled Electroche mical Deposition of Large-Area MoS2 on Graphene for High-Resp onsivity Photodetec tors, Advanced Functional Materials 2 7, 1603998 (2017)	No	Yes	Yes	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K
#J3, 2017	B. R.	. Xu, X. . Wang*, al.	Analyzing the Carrier Mobility in Transition- Metal Dichalcogen ide MoS ₂ Field-Effect Transistors, Advanced Functional Materials 2 7, 1604093 (2017)	No	Yes	No	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K
J#4, 2017	Z. Ec Be Un J. E.	. D. Liu, F. Chen, d. Parrott, en. SY. ng, B. Xu,* Pickwell- lacPherso	Graphene Based Terahertz Light Modulator in Total Internal Reflection Geometry, <i>Adv.</i> <i>Optical</i> <i>Materials</i> 5 , 1600697 (2017)	No	Yes	Yes	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K

#J5, 2017	Z. F. Chen, X. M. Li*, J. Q. Wang, L. Tao, M. Z. Long, S. J. Liang, L. K. Ang, Chester Shu, H. K. Tsang, JB. Xu*	Synergistic Effects of Plasmonics and Electron Trapping in Graphene Short-Wav e Infrared Photodetec tors with Ultrahigh Responsivi ty, ACS Nano 11, 430 (2017)	No	Yes	Yes	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K
#J6, 2016	X. Q. Tian, L. Liu, Z. R. Gong, Y. Du, J. Gu, B. I. Yakobson*, J. B. Xu	Unusual electronic and magnetic properties of lateral phosphore ne-WSe ₂ heterostruc tures, <i>J. of</i> <i>Materials</i> <i>Chemistry</i> 4 , 6657 (2016)	No	Yes	No	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K
#J7, 2016	X. L. Liu, X. G. Luo, J. B. Xu, X. R. Wang* , et al.	Crystals on Graphene for High-Effici ency Phototransi stors, <i>Advanced</i> <i>Materials</i> 28 , 5200 (2016)	No	Yes	Yes	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K
#J8, 2016	 B. Wu, Y. H. Zhao, H. Y. Nan, J. B. Xu, X. R. Wang, et al. 	Precise, Self-Limited Epitaxy of Ultrathin Organic Semiconduc tors and Heterojuncti ons Tailored by van der Waals Interactions, <i>Nano Lett.</i> 16 , 3754 (2016)	No	Yes	Yes	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K

#J9, 2016	L. Ye, H. Li, Z. F. Chen, J. B. Xu *	Near-Infrared Photodetector Based on MoS2/Black Phosphorus Heterojunctio n, ACS Photonics 3 , 692 (2016)	No	Yes	Yes	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K
#J10, 2016	X. Wan, K. Chen, W. G. Xie, & J. B. Xu*	Quantitative Analysis of Scattering Mechanisms in Highly Crystalline CVD MoS2 through a Self-Limited Growth Strategy by Interface Engineering, <i>Small</i> 12 , 438 (2016)	No	Yes	Yes	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K
#J11, 2016	Y. H. Zhang, Q. S. Qiao, J. B. Xu*, X. R. Wang*, et al.	Probing Carrier Transport and Structure-Pr operty Relationship of Highly Ordered Organic Semiconduc tors at the Two-Dimen sional Limit, <i>Phys. Rev.</i> <i>Lett.</i> 116 , 016602 (2016)	No	Yes	Yes	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K
#J12, 2016	J. Q. Wang, Z. Z. Cheng*, Z. F. Chen, J. B. Xu , et al.	High-respo nsivity graphene-o n-silicon slot waveguide photodetect ors, <i>Nanoscale</i> 8 , 13206 (2016)	No	Yes	Yes	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K

#J13,	K. Chen, X.		No	Yes	Yes	Yes
2016	Wan, W. G. Xie, J. B. Xu* , et al.	Built-In Potential of Monolayer MoS2-WS 2 In-Plane				http://aims .cuhk.edu. hk/converi s/portal?la
		Heterostru ctures by a Shortcut Growth				ng=zh_H K
		Strategy, <i>Advanced</i> <i>Materials</i> 27 , 6431 (2015)				
#J14, 2015	L. H. Liu, K. Xu, X. Wan, J. B. Xu , et al.	Enhanced optical Kerr nonlinearity of MoS ₂ on silicon waveguides, <i>Photonics</i> <i>Research</i> 3 , 206 (2015)	No	Yes	Yes	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K
#J15, 2015	K. Chen, X. Wan, J. B. Xu *, et al.	Electronic Properties of MoS2-WS2 Heterostruct ures Synthesized with Two-Step Lateral Epitaxial Strategy, <i>ACS Nano</i> 9 , 9868 (2015)	No	Yes	Yes	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K
#J16, 2015	Z. F. Chen, Z. Z. Cheng, J. Q. Wang, J. B. Xu* , et al.		No	Yes	Yes	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K
		<i>Materials</i> 3 , 1207 (2015)				

#J17, 2015	J. Q. Wang, Z. Z. Cheng, Z. F. Chen, J. B. Xu , et al.	photodetec tor integrated on silicon nitride waveguide, <i>J. Appl.</i> <i>Phys.</i> 117 , 144504 (2015)	No	Yes	Yes	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K
#J18, 2015	X. Q. Tian, L. Liu, Y. Du*, J. Gu, J. B. Xu , B. I. Yakobson	metal doping on electronic and magnetic properties of MoS ₂ nanoribbo ns, <i>Physical</i> <i>Chemistry</i> <i>Chemical</i> <i>Physics</i> 17 1831 (2015)	No	Yes	No	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K
#J19, 2015	X. Q. Tian*, L. Liu, L Y. Du, J. Gu, J. B. Xu , B. I. Yakobson	of lateral phosphore	Feb. 2015	Yes	No	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K
#J20, 2014	X. M. Wang, W. G. Xie, J. Chen, J. B. Xu *	Homo- and Hetero- p-n Junctions Formed on Graphene Steps, ACS Applied Materials & Interfaces 6 (1), 3-8 (2014)	Feb. 2015	Yes	Yes	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K

// 70.1	 V O T		D 1 0015	X 7		
#J21, 2014	X. Q. Tian, J. Gu, J. B. Xu *, et al.	Configurat ion-depen dent electronic and magnetic properties of graphene monolayer s and nanoribbo ns functionali zed with aryl groups, <i>Journal of</i> <i>Chemical</i> <i>Physics</i> 140 ,	Feb. 2015	Yes	Yes	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K
#J22, 2014	L. Shao, X. X. M. Wang, H. T. Xu, J. F. Wang, J. B. Xu* , L. M. Peng, H. Q. Lin	044712 (2014) Nanoanten na-Sandwi	Feb. 2015	Yes	Yes	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K
#J23, 2014	X. Q. Tian*, Y. D. Wei, S. A. Edwards, Y. J. Yu, X. M. Cai, J. B. Xu	(2014) Self-assem bly of carbon nanocluste	Feb. 2015	Yes	Yes	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K

#J24, 2014	X. M. Wang, W. G. Xie, J. B. Xu*	Based Non-Volat ile Memory Devices, <i>Advanced</i> <i>Materials</i> 26 (31), 5496-5503 (2014)	Feb. 2015		Yes	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K
#J25, 2014	D. W. He, Y. A. Zhang, Q. F. Q. Song, H. X. Xu, K. Watanabe, T. Taniguchi, J. B. Xu, X. R. Wang*, et al.	Two-dime nsional quasi-frees tanding molecular crystals for high-perfo rmance organic field-effec t transistors, <i>Nature</i> <i>Communic</i> <i>ations</i> 5 , Art. No. 5162 (2014), DOI:10.10 38/ncomm s6162	Feb. 2015	Yes	Yes	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K
#J26, 2014	X. Wan, K. Chen, J. B. Xu *	Interface Engineerin g for CVD Graphene: Current Status and Progress, <i>Small</i> 10 (22), 4443 (2014)	Feb. 2015	Yes	Yes	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K

#J27, 2013	X. M. Wang, H. T. Xu, J. Min, L. M. Peng, J. B. Xu *	Carrier Feb. 2015 sheet density constrained anomalous current saturation of graphene field effect transistors: kinks and negative differential	Yes	Yes	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K
#J28, 2013	K. Chen, K X. Wan, J. B. Xu*	resistances, Nanoscale 5, 2811 (2013) Controllab Feb. 2015 le modulatio n of the electronic properties of graphene and silicene by interface engineerin g and pressure, Journal of Materials Chemistry C 1 (32), 4869-4878 DOI:10.10 39/c3tc30 567h	Yes	Yes	Yes http://aims .cuhk.edu. hk/converi s/portal?la ng=zh_H K

#J29, 2013 X. Wan, K. Enhaneed Chen, J. Du, Performan D. Q. Liu, J. Jee and Chen, X. Lai, W. G. Xie, J. B. Xu* Femi- iculk.edu Femi- or or or Son Self-Asse mbled Monolayer Modified Substrates in Large Areas, Journal of Physical Chemistry C 117, 4800 (2013) Yes Yes Yes #J30, 2013 X. M. High-resp. Xu, H, K. 2013 High-resp. K. Chen, X. Law Feb. 2015 Yes Yes Yes #J31, 2013 K. Chen, X. K. K. K. K. K. K. K. K. K. K. K. K. K.
#J30, X. M. High-resp Variable High-resp Variable Feb. 2015 Yes Yes #J31, K. Chen, X. Gamitar Feb. 2015 Yes Yes #J31, K. Chen, X. Gamitar Feb. 2015 Yes Yes #J31, K. Chen, X. Gamitar Feb. 2015 Yes Yes #J31, K. Chen, X. Gamitar Feb. 2015 Yes Yes #J31, K. Chen, X. Gamitar Feb. 2015 Yes No #J31, K. Chen, X. Gamitar Feb. 2015 Yes No #J31, K. Chen, X. Gamitar Feb. 2015 Yes No #J31, K. Chen, X. Gamitar Feb. 2015 Yes No #J31, K. Chen, X. Gamitar Feb. 2015 Yes No #J31, K. Chen, X. Gamitar Feb. 2015 Yes No High-resp Wan, X.B. B. Xu* Feb. 2015 Yes No High-resp Sportal?le B. Xu* B. Xu* Feb. 2015 Yes No High-resp Wan, X.B. B. Xue Feb. 2015 Yes No High-resp Wan, X.B. Gamitar
#J30, X. M. K. J. B. K. J.
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#130, X. M. Bigh-resp son Self-Asse mbled Monolayer Modified Substrates in Large Areas, Journal of Physical Chemistry C 117, 4800 (2013) Yes Yes Yes #130, X. M. High-resp isilicon-het rsang*, J. Feb. 2015 Yes Yes #130, X. M. High-resp isilicon-het rsang*, J. Feb. 2015 Yes Yes #131, K. Chen, X. Output Yes Yes Yes #131, K. Chen, X. Quantativity or stattering W. G. Stie, J. Chen, Q. Yes No Yes Wang, X. D. Q. Liu, Z Garmantativity or stattering W. G. Stie, J. Chen, Q. Yes No Yes #J31, K. Chen, X. Quantativity or stattering W. G. Stie, J. Chen, Q. Yes No Yes Wino, J. B. Na're Mino, J. B. Iage-area graphene Yes No Yes
#130, X. M. High-resp. Feb. 2015 Yes Yes #131, K. Chen, X. graphenc/ silicon-het waveguide photodete tors, Nature Software #131, K. Chen, X. Quantitativ Feb. 2015 Yes No Yes #131, K. Chen, X. Quantitativ Feb. 2015 Yes No Yes #131, K. Chen, X. Quantitativ Feb. 2015 Yes No Yes Wan, X. D. e on of scattering waveguide photodete tors, Nature Nature Stattering waveguide tors, Nature Stattering waveguide tors, Nature Stattering waveguide tors, Stattering waveguide tors, Nature Stattering waveguide tors, Statt
#J30, X. M. High-resp (Chemistry) Chems, K. Xu, H. K. Feb. 2015 (Chem, K. Xu, H. K. Yes Yes #J31, K. Chen, X. Quita K. Chen, X. Wang, Z. Z. Nature Feb. 2015 (Chemistry) Chems, K. Xu, H. K. Feb. 2015 (Chemistry) Chems, K. Xu, H. K. Yes Yes #J31, K. Chen, X. Wang, Z. Z. Image Areas, Journal of Physical Chems, K. Xu, H. K. Feb. 2015 (Chems, K. Xu, H. K. Yes Yes B. Xu* K. Value Feb. 2015 (Chems, K. Xu, H. K. Yes Yes Yes B. Xu* K. Value Feb. 2015 (Chems, K. Xu, H. K. Yes Yes Yes B. Xu* K. Value Feb. 2015 (Chems, K. Xu, H. K. Yes No Yes B. Xu* K. Value Yes Yes No Yes #J31, K. Chen, X. Wang, J. B. Feb. 2015 (Chem, G. Nature Yes No Yes #J31, K. Chen, Q. Miao, J. B. Yes Yes No Yes #J31, K. Chen, Q. Miao, J. B. Yes Yes No Yes Yes Yes Yes Yes Yes Yortal?/z Yes Yes Yes
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#130, X. M. Substrates in Large Areas, Journal of Physical Chemistry C 117, 4800 (2013) Yes Yes #130, X. M. High-resp Wang, Z. Z. Feb. 2015 Yes Wang, Z. Z. onsivity Cheng, K. restructure graphene/ Yes Nu H. K. Tsang*, J. B. Xu* Silicon-het e silicon-het waveguide photodetec tors, Nature silicon-het Photonics silicon-het ros, Nature #J31, K. Chen, X. Quantitativ Q. Liu, Z. Feb. 2015 Yes No Wan, X.D. Q. Liu, Z. wan, X.D. on of scattering mechanism Yes No Wiao, J. B. X. Xa, Xu* Image-area graphene Feb. 2015 Yes No
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9. Recognized international conference(s) in which paper(s) related to this research project was/were delivered (*Please attach a copy of each delivered paper. All listed papers must acknowledge RGC's funding support by quoting the specific grant reference.*)

Month/Year/ Place	Title	Conference Name	Submitted to RGC (indicate the year ending of the relevant progress report)	this report	ed the	Accessible from the institutional repository (Yes or No)
#C1, June 11 - June 14, 2013, Bremen, Germany	Interface engineering for graphene synthesis and devices	Novel 2D materials: tuning electronic properties on the atomic scale,	Feb. 2015	Yes, http://www .cecam.org /workshop- 4-922.html	Yes	Yes http://aims.cuhk .edu.hk/converis /portal?lang=zh _HK
#C2,2013 年7 月31 日-8 月1 日,长春	Study of Interface Engineering for Graphene Synthesis and Devices	第8届全国暨华人 有机分子和聚合 物发光与光电特 性学术会	Feb. 2015	Yes	Yes	Yes http://aims.cuhk .edu.hk/converis /portal?lang=zh _HK
#C3, Sept. 5-7, 2013, Beijing, China	Investigation of Interface Properties for Graphene Synthesis and Devices	ChinaNano2013	Feb. 2015	Yes	Yes	Yes http://aims.cuhk .edu.hk/converis /portal?lang=zh _HK
#C4,2013年 8月8日-15 日,内蒙古 ・呼伦贝尔 市(原海拉 尔市)	单层石墨烯制 备暨石墨器件 的界面工程	第十届海峡两岸 纳米科学与技术 研讨会 (CSWNST10)	Feb. 2015	Yes	Yes	Yes http://aims.cuhk .edu.hk/converis /portal?lang=zh _HK
12月20~22	单层石墨烯制 备暨石墨器件 的界面工程	2013年纳米 表面 和Graphene科学 与技术全国会议	Feb. 2015	Yes	Yes	Yes http://aims.cuhk .edu.hk/converis /portal?lang=zh _HK
#C6, Dec. 15-18, 2013, Hong Kong, China	Device	International Conference on Interdisciplinary Nanoscience for Energy, Life and Environment (INELE 2013)	Feb. 2015	Yes	Yes	Yes http://aims.cuhk .edu.hk/converis /portal?lang=zh _HK
#C7, April 21-25, 2014, San Francisco, USA	Abnormal Absorption in Graphene/Silico n-Heterostructur e Waveguide	MRS Spring Meeting 2014	Feb. 2015	Yes	No	Yes http://aims.cuhk .edu.hk/converis /portal?lang=zh _HK

#C8, ETH,	On Graphene	International	Feb. 2015	Yes	Yes	Yes
June 2-3, $\frac{1}{2}$	Synthesis and	Symposium on	160. 2013	1 05	105	http://aims.cuhk
2014, Zurich,		Synthetic				.edu.hk/converis
	Interface	2-dimensional				/portal?lang=zh
Switzerland	Engineering	Polymers				HK
#C0 Inly			Eab 2015	Yes	Vag	Yes
#C9, July	Interface	IEEE Photonic	Feb. 2015	Y es	Yes	
14-17, 2014,	Engineering and					http://aims.cuhk
Montreal,	Hybrid	Meeting				.edu.hk/converis
Canada	Structures for					/portal?lang=zh
	Graphene					_HK
	Transistors and					
	Photodetectors					
#C10,	石墨烯光电探	Chinese Vacuum	Feb. 2015	Yes	Yes	Yes
November	测及晶体管的	Society Annual				http://aims.cuhk
7-9, 2014,	界面工程	Meeting				.edu.hk/converis
Guangzhou						/portal?lang=zh
						_HK
#C11, June	Nanoscopic	International	No	Yes	Yes	Yes
28 – July 3,	Investigation on	Conference on				http://aims.cuhk
2015,	Graphene and	Advanced				.edu.hk/converis
Singapore	its Related	Materials				/portal?lang=zh
	Devices	Technologies				HK
#C12,	Study of	China	No	Yes	Yes	Yes
Sept.3-5,	Graphene-like	International				http://aims.cuhk
2015,	Materials and	Conference on				.edu.hk/converis
Beijing	Related Devices					/portal?lang=zh
- 5 8		Nanotechnology				HK
#C13, Sept	Investigation on	Annual Meeting	No	Yes	Yes	Yes
	Graphene and	of Chinese				http://aims.cuhk
Changchun	MoS_2 and their	Physical Society				.edu.hk/converis
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#C14, Oct.	Investigation of	2015 International	No	Yes	Yes	Yes
· · ·	Graphene and	Graphene	110	105	105	http://aims.cuhk
Qingdao		Innovation				.edu.hk/converis
Qinguao	Materials	Conference,				/portal?lang=zh
	iviaterials	plenary				HK
		presentation				- ^{111X}
#C15, Jan.	Exploration of	2nd International	No	Yes	Yes	Yes
7-9, 2016	Electronic	Conference on	INU	1 05	1 65	http://aims.cuhk
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Hong Kong	Materials and Interface					.edu.hk/converis
		Layered Materials				/portal?lang=zh
	Engineering in					_HK
#016 I	the Flatland	T	N	V	V	V
#C16, June	Adventure of	International	No	Yes	Yes	Yes
30-July 2,	Electronic	Symposium on				http://aims.cuhk
2016,	Nanomaterials	Devices and				.edu.hk/converis
Shanghai	in the Flatland	Applications of				/portal?lang=zh
		Two-Dimensional				_HK
		Materials				

#C17, July 31-August 5, 2016, Beijing	Understanding of Scattering Mechanisms in Highly Crystalline CVD Graphene and MoS ₂ through Interface Engineering	International Conference on Semiconductor Physics	No	Yes	Yes	Yes http://aims.cuhk .edu.hk/converis /portal?lang=zh _HK
#C18, Oct. 28-30, 2015, Qingdao	Progress of Electronic Nanomaterials in the Flatland	2016 International Graphene Innovation Conference, plenary presentation	No	Yes	Yes	Yes http://aims.cuhk .edu.hk/converis /portal?lang=zh _HK

10. Student(s) trained (*Please attach a copy of the title page of the thesis.*)

Name	Degree registered for	Date of registration	Date of thesis
			submission/
			graduation
Xi WAN	PhD	August, 2009	September, 2013
Kun CHEN	PhD	August, 2009	May, 2013
Zefeng CHEN	PhD	August, 2013	May, 2017
Hao LI	PhD	August, 2013	August, 2017

11. Other impact (e.g. award of patents or prizes, collaboration with other research *institutions, technology transfer, etc.*)

1. Interface Engineering for Graphene Transistors and Photodetectors (石墨烯晶体管及其光电 探测器的界面工程研究); Class II of the 2014 Natural Science Awards, Ministry of Education, China (2014年度高等學校科學研究優秀成果獎(科學技術)二等奖; 中華人民共和國教育部)

Jian-Bin XU, Xiaomu Wang, Xi Wang, Kun Chen, Hon Ki Tsang, Zhenzhou Cheng, Wei-Guang Xie, Xiao-qing Tian (許建斌, 王肖沐, 萬茜, 陳琨, 曾漢奇, 程振洲, 謝偉廣, 田曉慶), see more at <u>http://www.cutech.edu.cn/cn/zxgz/2014/12/1417370527164216.htm</u>

2. Jian-Bin Xu, named as Chang Jiang Scholar Chair Professor by Ministry of Education, China; tenable to School of Electronic Science and Engineering, Nanjing University, Nov., 2014. See more at: <u>http://www.moe.edu.cn/publicfiles/business/htmlfiles/moe/s5972/201411/177981.html</u> The success is partially related to the current research project. The two teams will collaborate and exchange more, according to the required activities and duties under the Scheme of Chang Jiang Scholars.

3. Jian-Bin Xu, named as Vice-Chancellor's Outstanding Fellow of Faculty of Engineering, The Chinese University of Hong Kong, Aug. 1, 2014- July 31, 2019.

4. Jian-Bin Xu, Recipient of Research Excellence Award, Faculty of Engineering, The Chinese University of Hong Kong, October, 2015

5. Jian-Bin Xu, named as Outstanding Researcher of The Chinese University of Hong Kong, by Nature Index 2014.