RGC Ref.: A-HKUST605/16
(please insert ref. above)

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

(Please attach a copy of the completion report submitted to the ANR by the French researcher)

Part A: The Project and Investigator(s)

1. Project Title (ANR Acronym)

Polymer Nanostructures with Aggregation-Induced Emission Properties for Bioimaging and Theranostics (AIE-Nanopoly)

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

	Hong Kong Team	French Team
Name of Principal Investigator *(with title)*	Prof. Ben Zhong Tang	Prof. Min-Hui Li
Post	Chair Professor	Research Professor
Unit / Department / Institution	Department of Chemistry/ The Hong Kong University of Science and Technology	The National Center for Scientific Research/Research Institute of Chemistry, Paris
Contact Information	E-mail: tangbenz@ust.hk	E-mail: min-hui.li@chimieparistech.psl.eu
Co-investigator(s) *(with title and institution)*	N/A	Dr. Macro Sergio (Research Director, Curie Institute)

3. Project Duration

	Original	Revised	Date of RGC/ Institution Approval *(must be quoted)*
Project Start date	1-3-2017	1-3-2017	N/A
Project Completion date	29-2-2020	31-10-2020	3-10-2019
Duration *(in month)*	36	44	N/A
Deadline for Submission of Completion Report	28-2-2021	31-10-2021	N/A

Part B: The Completion Report

5. Project Objectives

5.1 Objectives as per original application

The French teams of this international collaborative project are specialists in the polymer synthesis, the polymer self-assembling and the design of stimuli-responsive polymersomes, and the Hong Kong team is the frontier research group to design, synthesize and investigate AIE luminescent materials. With the complementary strengths, together we propose to develop: (1) light-up AIE polymersomes and (2) AIE fluorescent polymersomes. The light-up AIE polymersomes represent a totally new system, where water-soluble AIEgen-conjugates are encapsulated in the inner aqueous compartment of polymer vesicles. The stimuli-responsive opening of the polymersomes and the specific cleavage of the AIEgens-conjugates will activate the fluorescence of AIEgens. The polymer nanostructures will ensure the long systemic circulation and favor the *in vivo* applications. The specific light-up AIEgen-conjugates show advantages of low background interference, high signal to noise ratio, superior photostability and possibly activatable therapeutic effects if pro-drug is introduced in the conjugates. The AIE fluorescent polymersomes take advantage of the big hydrophobic pockets in the polymer membrane that will house AIEgens of a normally rigid hydrophobic nature. We will investigate the photophysical properties of AIE fluorescent polymersomes or polymer nanoparticles on the basis of their molecular and soft-

condensed-matter structures in order to obtain ultra-bright fluorescent nanoparticles. We will also evaluate their potential application in bioimaging, theranostics and biosensors.

5.2 Revised Objectives

No revision was made

Date of approval from the RGC: _____

Reasons for the change: _____

_____

1.
2.
3. ....

6. Research Outcome

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

The development of new luminescent materials has allowed us to gain unprecedented knowledge and opening a new avenue to scientific achievement and societal development. In this project, we have developed new but simple method for preparing AIEgens and their polymers. Most of them are synthesized in high yields and all the polymers obtained possess high molecular weights and good solubility. Their nanoparticles and their dots with biocompatible polymers exhibit strong light emission, a large Stokes shift, good biocompatibility, and high photostability. These characteristics make them promise as visualizing agents for bioimaging. Indeed, when specific groups or charges are introduced into their structures, they can specifically target to cancer cells, organelles in living cells, bacteria, and fungi. Upon light irradiation, they can generate reactive oxygen species in an efficient way, suggesting that they can serve as efficient photosensitizers for image-guided photodynamic therapy.

We have also developed a donor-acceptor strategy to red-shift the emission of AIEgens to second near-infrared (NIR-II, 1000-1700 nm) as fluorescence imaging in this spectral region have shown great promise for in vivo imaging of small animals such as mice and rats. Indeed, the NIR-II AIE dots prepared in this proposal allow in vivo deep-tissue imaging, visualization of brain vasculature with high spatial resolution, high signal-to-

background ratio and deep penetration, intraoperative identification of ureters, etc. Induction of molecular motion inside the nanoparticles will enable most of the absorbed light energy to dissipate as heat. Such a property makes the nanoparticles a superior theranostic agent for photoacoustic imaging and photothermal therapy.

We have further developed strategies to endow AIEgens and their polymers with additional functionalities and enhanced properties and specificity to analytes. For example, when silver nanoparticles (AgNP) are incorporated into AIEgens, the resulting hybrids can perform multimodality imaging in living cells and animals. On the other hand, gold(I)-containing AIEgens can efficiently inhibit the growth of cancer cells due to their strong inhibition towards thioredoxin reductase. They can act as a powerful radiosensitizer to boost the anticancer efficacy with performance superior to that of popularly used auranofin. To enhance the specificity of AIEgens to cancer cells, we have developed methods to fabricate aptamer (Apt)-decorated self-assembled AIE dots with With integration of the strong light emission of AIEgens and the cell-targeting capability of aptamers, the as-prepared Apt-AIE organic nanodots can specifically target to cancer cells with good biocompatibility, high image contrast and excellent photostability. As aptamers and AIEgens are rich in category, a variety of biocompatible organic fluorescent nanoprobes with specific recognition, high sensitivity, and tracking capability can be facilely constructed, paving the way for long-term, real-time, and dynamic sensing, tracking, and imaging applications. An in vivo metabolic labeling strategy for tumor-specific delivery of AIE dots and targeting imaging was also developed as well.

As you can see in part C of this report, more than 35 publications have arisen from this research project and most of the papers are published in journal articles with high impact factors. We are confident that further research in this field will lead to more fruitful result.

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

There is still a high demand on the development of novel luminogenic materials with easy preparation and functionalization, stable structures, tunable emissions, and high quantum efficiency. In this project, we have developed new methods for synthesizing AIEgens and their polymers. The nanoparticles fabricated from these materials exhibit good biocompatibity, strong light emission, a large Stokes shift, high photostability and strong ability to generate reactive oxygen species. Such characteristics make them promise as theranostic agents for specifically target to cancer cells, organelles in living cells, bacteria and fungi, and their killing by photodynamic or photothermal therapy. They can be further functionalized to enhance their existing performances and/or impart new properties and biological applications.

Thus, although the project completion date has passed, we are still working on the exploration of new systems, especially those that show emission in the NIR-II window with long excitation wavelengths. Moreover, most existing AIE photosensitizers still suffer the problems of limited penetration depth, low ROS generation efficiency in hypoxia environment of solid tumors. If we can get further support from RGC, we will hire more people to solve these problems and explore more new biological applications.

7. The Layman's Summary

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

Luminogenic materials showing strong light emission have found promise biomedical applications. In this project, we have developed new methods for molecules and their polymers with aggregation-induced emission (AIE) characteristics. Unlike the traditional ones, these materials show no emission in solution but emit intensely in the aggregate state. Their nanoparticles show good biocompatibity, strong light emission and strong ability to generate reactive oxygen species. Such characteristics make them promise candidates for specifically target to cancer cells, organelles in living cells, bacteria and fungi, and their killing.

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 Latest Status of Publications				Author(s) ***(bold** the authors belonging to the project teams and denote the corresponding author with an asterisk*)*	Title and Journal/ Book *(with the volume, pages and other necessary publishing details specified)*	Submitted to RGC *(indicate the year ending of the relevant progress report)*	Attached to this report *(Yes or No)*	Acknowledged the support of this Joint Research Scheme *(Yes or No)*	Accessible from the institutional repository *(Yes or No)*
Year of publication	Year of Acceptance *(For paper accepted but not yet published)*	Under Review	Under Preparation *(optional)*						
2021				Li, Q.; Gong, J.; Li, Y.; Zhang, R.; Wang, H.; Zhang, J.; Yan, H.; Lam, J. W. Y.; Sung, H. H. Y.; Williams, I. D.; Kwok, R. T. K.; **Li, M-Hu**.; Wang, J*.; **Tang, B. Z***	"Unusual light-driven amplification through unexpected regioselective photogeneration of fivemembered azaheterocyclic AIEgen" *Chem. Sci.* **2021**, *12*, 709	2021	Yes	Yes	Yes
2020				Zhang, R.; Niu, G.; Lu, Q.; Huang, X.; Chau, J. H. C.; Kwok, R. T. K.; Yu, X.; **Li, M-H***.; Lam, J. W. Y*.; **Tang, B. Z***	"Cancer cell discrimination and dynamic viability monitoring through wash-free bioimaging using AIEgens" *Chem. Sci*. **2020**, *11*, 7676	2021	Yes	Yes	Yes

2020				Qi, J.; Alifu, N.; Zebibula, A.; Wei, P.; Lam, J. W. Y.; Peng, H.-Q.; Kwok, R. T. K.; Qian, J*.; Tang, B. Z*.	"Highly Stable and Bright AIE Dots for NIR-II Deciphering of Living Rats" *Nano Today* **2020**, *34*, 100893 (1–10)	2021	Yes	Yes	Yes
2020				Li, Y.; Liu, S.; Ni, H.; Zhang, H.; Zhang, H.; Chuah, C.; Ma, C.; Wong, K. S.; Lam, J. W. Y.; Kwok, R. T. K.; Qian, J*.; Lu, X*.; Tang, B. Z*.	"ACQ-to-AIE Transformation: Tuning Molecular Packing by Regioisomerization for Two-photon NIR Bioimaging" *Angew. Chem. Int. Ed.* **2020**, *59*, 12822–12826.	2021	Yes	Yes	Yes
2020				Li, Q.; Li, Y.; Min, T.; Gong, J.; Du, L.; Phillips, D. L.; Liu, J.; Lam, J. W. Y.; Sung, H. H. Y.; Williams, I. D.; Kwok, R. T. K.; Ho, C. L.; Li, K.; Wang, J*.; Tang, B. Z*.	"Time-dependent Photodynamic Therapy for Multiple Targets: A Highly Efficient AIE-active Photosensitizer for Selective Bacterial Elimination and Cancer Cell Ablation" *Angew. Chem. Int. Ed.* **2020**, *59*, 9470–9477.	2021	Yes	Yes	Yes

2020				Zhang, J.; Zou, H.; Lei, J.; He, B.; He, X.; Sung, H. H. Y.; Kwok, R. T. K*.; Lam, J. W. Y.; Zheng, L*.; Tang, B. Z*.	"Multifunctional Au^{I}-based AIEgens: Manipulating Molecular Structures and Boosting Specific Cancer Cell Imaging and Theranostics" *Angew. Chem. Int. Ed.* **2020**, *59*, 7097–7105.	2021	Yes	Yes	Yes
2020				Bai, H.; Liu, Z.; Zhang, T.; Du, J.; Zhou, C.; He, W.; Chau, J.; Kwok, R. T. K.; Lam, J. W. Y.; Tang, B. Z*.	"Multifunctional Supramolecular Assemblies with Aggregation-Induced Emission (AIE) for Cell Line Identification, Cell Contamination Evaluation and Cancer Cell Discrimination" *ACS Nano* **2020**, *14*, 7552–7563.	2021	Yes	Yes	Yes
2020				Qi, J.; Duan, X.; Cai, Y.; Jia, S.; Chen, C.; Zhao, Z.; Li, L.; Peng, H.-Q.; Kwok, R. T. K.; Lam, J. W. Y.; Ding, D*.; Tang, B. Z*.	"Simultaneously Boosting the Conjugation, Brightness and Solubility of Organic Fluorophores by using AIEgens" *Chem. Sci.* **2020**, *11*, 8438–8447.	2021	Yes	Yes	Yes

2020				Zhou, C.; Jiang, M.; Du, J.; Bai, H.; Shan, G.; Kowk, R. T. K.; Chau, J. H. C.; Zhang, J.; Lam, J. W. Y.; Huang, P.; Tang, B. Z*.	"One Stone, Three Birds: One AIEgen with Three Colors for Fast Differentiation of Three Pathogens" *Chem. Sci.* **2020**, *11*, 4730–4740.	2021	Yes	Yes	Yes
2020				Shi, X.; Yan, N.; Niu, G.; Sung, S. H. P.; Liu, Z.; Liu, J.; Kwok, R. T. K*.; Lam, J. W. Y.; Wang, W.-X*.; Sung, H. H.-Y.; William, I. D.; Tang, B. Z*.	"In Vivo Monitoring of Tissue Regeneration using A Ratiometric Lysosomal AIE Probe" *Chem. Sci.* **2020**, *11*, 3152–3163.	2021	Yes	Yes	Yes
2020				Zheng, Z.; Liu, H.; Zhai, S.; Zhang, H.; Shan, G.; Kwok, R. T. K.; Ma, C.; Sung, H. H. Y.; Williams, I. D.; Lam, J. W. Y.; Wong, K. S.; Hu, X*.; Tang, B. Z*.	"Highly Efficient Singlet Oxygen Generation, Two-Photon Photodynamic Therapy and Melanoma Ablation by Rationally Designed Mitochondria-Specific Near-Infrared AIEgens" *Chem. Sci.* **2020**, *11*, 2494–2503.	2021	Yes	Yes	Yes

2020				Qi, J.; Duan, X.; Liu, W.; Li, Y.; Cai, Y.; Lam, J. W. Y.; Kwok, R. T. K.; Ding, D*.; Tang, B. Z*.	"Dragonfly-Shaped Near-Infrared AIEgen with Optimal Fluorescence Brightness for Precise Image-Guided Cancer Surgery" *Biomaterials* **2020**, *248*, 120036 (1–9).	2021	Yes	Yes	Yes
2020				Liu, S.; Chen, C.; Li, Y.; Zhang, H.; Liu, J.; Wang, R.; Wong, S. T. H.; Lam, J. W. Y.; Ding, D*.; Tang, B. Z*.	"Constitutional Isomerization Enables Bright NIR-II AIEgen for Brain-Inflammation Imaging" *Adv. Funct. Mater.* **2020**, *30*, 1908125 (1–10).	2021	Yes	Yes	Yes
2020				Li, Y.; Cai, Z.; Liu, S.; Zhang, H.; Wong, S. T. H.; Lam, J. W. Y.; Kwok, R. T. K.; Qian, J*.; Tang, B. Z*.	"Design of AIEgens for Near-Infrared IIb Imaging through Structural Modulation at Molecular and Morphological Levels" *Nat. Commun.* **2020**, *11*, 1255 (1–10).	2021	Yes	Yes	Yes

2020				Du, J.; Liu, S.; Zhang, P.; Liu, H.; Li, Y.; He, W.; Li, C.; Chau, J.; Kwok, R. T. K.; Lam, J. W. Y.; Cai, L.; Huang, Y.; Zhang, W*.; Hou, J*.; Tang, B. Z*.	"Highly Stable and Bright NIR-II AIE Dots for Intraoperative Identification of Ureter" *ACS Appl. Mater. Interf.* **2020**, *12*, 8040–8049.	2021	Yes	Yes	Yes
2019				Zheng, Z.; Li, D.; Liu, Z.; Peng, H.-Q.; Sung, H. H. Y.; Kwok, R. T. K.; Williams, I. D.; Lam, J. W. Y.; Qian, J*.; Tang, B. Z*.	"Aggregation-Induced Nonlinear Optical Effects of AIEgen Nanocrystals for Ultradeep In Vivo Bioimaging" *Adv. Mater.* **2019**, *31*, 1904799 (1–11).	2021	Yes	Yes	Yes
2019				Zhang, W.; Huang, Y.; Chen, Y.; Zhao, E.; Hong, Y.; Chen, S.; Lam, J. W. Y.; Chen, Y.; Hou, J*.; Tang, B. Z*..	"Amphiphilic Tetraphenylethene-Based Pyridinium Salt for Selective Cell-Membrane Imaging and Room-Light-Induced Special Reactive Oxygen Species Generation" *ACS Appl. Mater. Interf.* **2019**, *11*, 10567–10577	2021	Yes	Yes	Yes

2018				Chen, M.; Xie, W.; Li, D.; Zebibula, A.; Wang, Y.*; Qian, J.; Qin, A.; Tang, B. Z.*	"Utilizing a Pyrazine-Containing Aggregation-Induced Emission Luminogen as an Efficient Photosensitizer for Imaging-Guided Two-Photon Photodynamic Therapy" *Chem. A. Euro. J.* **2018**, *24*, 16603	2019	No	Yes	Yes
2018				Liu, S.; Zhang, H.; Li, Y.; Liu, J.; Du, L.; Chen, M.; Kwok, R. T. K.; Lam, J. W. Y.; Phillips, D. L.; Tang, B. Z.*	"Strategies to Enhance the Photosensitization: Polymerization and the Donor-Acceptor Even-Odd Effect" *Angew. Chem. Inter. Ed.* **2018**, *57*, 15189	2019	No	Yes	Yes
2019				Zhao, Z.; Chen, C.; Wu, W.; Wang, F.; Du, L.; Zhang, X.; Xiong, Y.; He, X.; Cai, Y.; Kwok, R. T. K.; Lam, J. W. Y.; Gao, X.; Sun, P.; Phillips, D. L.; Ding, D*.; Tang, B. Z*	"Highly Efficient Photothermal Nanoagent Achieved by Harvesting Energy via Excited-state Intramolecular Motion within Nanoparticles" *Nat. Commnu.* **2019**, *10*, 768.	2019	No	Yes	Yes

2019				Zhang, P.; Jiang, T.; Li, Y.; Zhao, Z.; Gong, P.; Cai, L.; Kwok, R. T. K.; Lam, J. W. Y.; Gu, X.*; Tang, B. Z.*	"Bio-orthogonal AIE Dots Based on Polyyne-Bridged Red-emissive AIEgen for Tumor Metabolic Labeling and Targeted Imaging" *Chem. Asian. J.* **2018**, *14*, 770.	2019	No	Yes	Yes
2019				Xu, W.; Lee, M. M. S.; Zhang, Z.; Sung, H. H. Y.; Williams, I. D.; Kwok, R. T. K.; Lam, J. W. Y.; Wang, D.*; Tang, B. Z.*	"Facile Synthesis of AIEgens with Wide Color Tunability for Cellular Imaging and Therapy" *Chem. Sci.* **2019**, 10, 3494.	2019	No	Yes	Yes
2019				He, X.; Yin, F.; Wang, D.; Xiong, L.; Kwok, R. T. K.; Gao, P.; Zhao, Z.; Lam, J. W. Y.; Yong, K. T.; Li, Z.*; Tang, B. Z.*	"AIE Featured Inorganic-Organic Core@Shell Nanoparticles for High-Efficiency siRNA Delivery and Real-Time Monitoring" *Nano Lett.* **2019**, *19*, 2272.	2019	No	Yes	Yes
2019				Liu, S.; Zhou, X.; Zhang, H.; Ou, H.; Lam, J. W. Y.; Liu, Y.; Shi, L.*; Ding, D.*; Tang, B. Z.*	"Molecular Motion in Aggregates: Manipulating TICT for Boosting Photothermal Theranostics" *J. Am. Chem. Soc.* **2019**, 141, 5359.	2019	No	Yes	Yes

2019				Zhang, T.; Li, Y.; Zheng, Z.; Ye, R.; Zhang, Y.; Kwok, R. T. K.; Lam, J. W. Y.; Tang, B. Z.*	"In Situ Monitoring Apoptosis Process by a Self-Reporting Photosensitizer" *J. Am. Chem. Soc.* **2019**, *141*, 5612.	2019	No	Yes	Yes
2019				Liu, X.; Li, M.; Han, T.; Cao, B.; Qiu, Z.; Li, Y.; Li, Q.; Hu, Y.; Liu, Z.; Lam, J. W. Y.*; Hu, X.*; Tang, B. Z.*	"In Situ Generation of Azonia-Containing Polyelectrolytes for Luminescent Photopatterning and Superbug Killing" *J. Am. Chem. Soc.* **2019**, *141*, 11259.	2019	No	Yes	Yes
2019				Hu, Y.; Han, T.; Yan, N.; Liu, J.; Liu, X. ; Wang, W. X.; Lam, J. W. Y.*; Tang, B. Z.*	"Visualization of Biogenic Amines and In Vivo Ratiometric Mapping of Intestinal pH by AIE-Active Polyheterocycles Synthesized by Metal-Free Multicomponent Polymerizations" *Adv. Func. Mater.* **2019**, 29, 1902240	2019	No	Yes	Yes

2018				Qi, J.; Sun, C.; Li, D.; Zhang, H.; Yu, W.; Zebibula, A.; Lam, J. W. Y.; Xi, W.; Zhu, L.; Cai, F.; Wei, P.; Zhu, C.; Kwok, R. T. K.; Streich, L. L.; Prevedel, R.; Qian, J*.; Tang, B. Z*	"Aggregation-Induced Emission Luminogen with Near-Infrared-II Excitation and Near-Infrared-I Emission for Ultradeep Intravital Two-Photon Microscopy" *ACS Nano* **2018**, *12*, 7936-7945	2018	No	Yes	Yes
2018				Zheng, Z.; Zhan, T.; Liu, H.; Chen, Y.; Kwok, T. K.; Ma, C.; Zhang, P.; Sung, H. H. Y.; Williams, I. D.; Lam, J. W. Y.; Wong, K. S. Tang, B. Z*	"Bright Near-Infrared Aggregation-Induced Emission Luminogens with Strong Two-Photon Absorption, Excellent Organelle Specificity, and Efficient Photodynamic Therapy Potential" *ACS Nano* **2018**, *12*, 8145-8159	2018	No	Yes	Yes
2018				Gu, X.; Zhang, X.; Ma, H.; Jia, S.; Zhang, P.; Zhao, Y.; Liu, Q.; Wang, J.; Zheng, X.; Lam, J. W. Y.; Ding, D*.; Tang, B. Z*	"Corannulene-Incorporated AIE Nanodots with Highly Suppressed Nonradiative Decay for Boosted Cancer Phototheranostics in Vivo" *Advanced Materials* **2018**, *30*, 1801065 (1-9).	2018	No	Yes	Yes

2018				He, X.; Zhao, Z.; Xiong, L.-H.; Gao, P. F.; Peng, C.; Li, R. S.; Xiong, Y.; Li, Z.; Sung, H.; Williams, I. D.; Kwok, R. T. K.; Lam, J. W. Y.; Huang, C. Z.; Ma, N.; Tang, B. Z*	"Redox-active AIEgen Derived Plasmonic and Fluorescent Core@shell Nanoparticles for Multimodality Bioimaging" *Journal of the American Chemical Society* **2018**, *140*, 6904–6911.	2018	No	Yes	Yes
2018				Gao, Q.; Qiu, Z.; Elsegood, M. R. J.; Chen, M.; Wang, J.; Kwok, R. T. K.; Lam, J. W. Y*.; Tang, B. Z*	"Regio- and Stereoselective Polymerization of Diynes with Inorganic Comonomer: A Facile Strategy to Conjugated Poly(*p*-arylene dihalodiene)s with Processability and Postfunctionalizability" *Macromolecules* **2018**, 51, 3497-3503	2018	No	Yes	Yes
2018				Jiang, M.; Kwok, R. T. K.; Li, X.; Gui, C.; Lam, J. W. Y.; Qu, J.; Tang, B. Z*	"A Simple Mitochondrial Targeting AIEgen for Image-Guided Two-Photon Excited Photodynamic Therapy" *Journal of Materials Chemistry B* **2018**, *6*, 2557–2565.	2018	No	Yes	Yes

2018				Chen, Y.; Zhang, W.; Zhao, Z.; Cai, Y.; Gong, J.; Kwok, R. T. K.; Lam, J. W. Y.; Sung, H. H. Y.; Williams, I. D.; Tang, B. Z*	"An Easily Accessible Ionic Aggregation-induced Emission Luminogen with Hydrogen Bonding Switchable Emission and Wash-free Imaging Ability" *Angewandte Chemie International Edition* **2018**, 130, 5105-5109	2018	No	Yes	Yes
2018				Qin, W.; Zhang, P.; Li, H.; Lam, J. W. Y.; Cai, Y.; Kwok, R. T. K.; Qian, J.; Zheng, W.; Tang, B. Z*	"Ultrabright Red AIEgens for Two-Photon Vascular Imaging with High Resolution and Deep Penetration" *Chemical Science* **2018**, *9*, 2705–2710.	2018	No	Yes	Yes
2018				Zhang, W.; Yu, C. Y. Y.; Kwok, R. T. K.; Lam, J. W. Y.; Tang, B. Z*	"A Photostable AIE Luminogen with Near Infrared Emission for Monitoring Morphological Change of Plasma Membrane" *Journal of Materials Chemistry B* **2018**, *6*, 1501–1507.	2018	No	Yes	Yes

2018				Zhang, P.; Zhao, Z.; Li, C.; Su, H.; Wu, Y.; Kwok, R. T. K.; Lam, J. W. Y.; Gong, P.; Cai, L*.; Tang, B. Z*	"Aptamer-Decorated Self-Assembled AIE Organic Dots for Cancer Cell Targeting and Imaging" *Analytical Chemistry* **2018**, *90*, 1063–1067.	2018	No	Yes	Yes
2018				Jiang, M.; Gu, X.; Kwok, R. T. K.; Li, Y.; Sung, H. H. Y.; Zheng, X.; Zhang, Y.; Lam, J. W. Y.; Williams, I. D.; Huang, X.; Wong, K. S.; Tang, B. Z*	"Multifunctional AIEgens: Ready Synthesis, Tunable Emission, Mechanochromism, Mitochondrial and Bacterial Imaging" *Advanced Functional Materials* **2018**, *28*, 1704589 (1-11).	2018	No	Yes	Yes
2018				Gao, X.; Cai, J.; Song, Y.; Shu, X.; Liu, J.; Sun, J. Z.; Liu, B*.; Tang, B. Z*	"A Unimolecular Theranostic System with H_2O_2-Specific Response and AIE Activity for Doxorubicin Releasing and Real-Time Tracking in Living Cells" *RSC Advances* **2018**, *8*, 10975–10979.	2018	No	Yes	Yes

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)*	Attached to this report *(Yes or No)*	Acknowledged the support of this Joint Research Scheme *(Yes or No)*	Accessible from the institutional repository *(Yes or No)*
24–25 Sept/ 2020/Hong Kong	AIEgens for Optoelectronic and Biomedical Applications	International Conference on Wearable Electronics and Their Potential in Modernization of Chinese Medicine	2021	Yes	Yes (the abstract does not contain an acknowledge section but we orally acknowledge the support of RGC in the talk	No
15 Jan/2020/ Denmark	AIE Luminogens: A Family of Conceptually New Nanomaterials	The 17th iNANO Annual Meeting, Aarhus University	2021	Yes	Yes (the abstract does not contain an acknowledge section but we orally acknowledge the support of RGC in the talk)	No
18April/201 9/Nanjing	AIE-Active Biomedical Materials	National Meeting on Biomedical Polymer Materials	2019	No	Yes (the abstract does not contain an acknowledge section but we orally acknowledge the support of RGC in the talk)	No
24–26 May 2019/Cixi	AIE Luminogens and Theronostics”	2019 International Academician Conference on Biomedicine and Materials	2019	No	Yes (the abstract does not contain an acknowledge section but we orally acknowledge the support of RGC in the talk)	No

24-29 June/2018/Hong Kong	"AIE Nanoaggregates for Biomedical Applications"	The 14th International Conference on Nanostructured Materials	2018	No	Yes (the abstract does not contain an acknowledge section but we orally acknowledge the support of RGC in the talk)	No
23–26 Oct/ 2017/ Beijing	"Sensing and Imaging by AIEgens"	The 2nd Asian Conference on Chemosensors and Imaging Probes	2018	No	Yes (the abstract does not contain an acknowledge section but we orally acknowledge the support of RGC in the talk)	No

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
Zhang Tianfu	Doctor of Philosophy	Sept 2017	Aug 2021
Lee Mei Suet	Doctor of Philosophy	Sept 2017	Aug 2021
Liu Haixiang	Doctor of Philosophy	Sept 2016	Aug 2020
He Xuewen	Doctor of Philosophy	Sept 2016	Aug 2019

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

N/A

12. Statistics on Research Outputs *(Please ensure the summary statistics below are consistent with the information presented in other parts of this report.)*

	Peer-reviewed journal publications	Conference papers	Scholarly books, monographs and chapters	Patents awarded	Other research outputs (Please specify)
No. of outputs arising directly from this research project	39	6	0	0	N/A