RGC Ref.: A-HKU704/12
(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)

Phosphorus-Containing π-Conjugated Molecular Materials - Design, Synthesis and Their Supramolecular Assembly for Light-Emitting, Light-Harvesting, Electronic Communication and Charge Transport Functions (**P-OPTOELECTR-MOLMAT**)

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

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

	Hong Kong Team	French Team
Name of Principal Investigator *(with title)*	YAM Wing-Wah Vivian (Prof.)	HISSLER Muriel (Prof.)
Post	Chair Professor	Professor
Unit / Department / Institution	Department of Chemistry The University of Hong Kong	Institut des Sciences Chimique de Rennes - UMR 6226 CNRS Université de Rennes 1
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Co-investigator(s) *(with title and institution)*	CHAN Mei-Yee (Maggie) (Dr.) WONG Man-Chung (Keith) (Dr.) *Department of Chemistry* *The University of Hong Kong*	LAPINTE Claude (Dr.) HALET Jean-François (Dr.) LESCOP Christophe (Dr.) *Inst Sci Chim Rennes – UMR 6226 CNRS, Univ Rennes 1*
Other Team Members (with title) Unit / Department / Institution	WONG Hok-Lai (Dr.) LEUNG Yu-Lut (Sammual) (Dr.) HONG Yau-Hin Eugene (Dr.) CHAN Kwun-Wa Alan (Dr.) *Department of Chemistry* *The University of Hong Kong*	COSTUAS Karine (Dr.) LE GUENNIC Boris (Dr.) *Inst Sci Chim Rennes – UMR 6226 CNRS, Univ Rennes 1*

3. Project Duration

	Original	Revised	Date of RGC/ Institution Approval *(must be quoted)*
Project Start date	1 Feb 2013		
Project Completion date	31 Jan 2017		
Duration *(in month)*	48		
Deadline for Submission of Completion Report	31 Jan 2018		

Part B: The Completion Report

5. Project Objectives

5.1 Objectives as per original application

1. To design, synthesize, and characterize various functionalized phosphorus-containing molecules, π-conjugated molecules and donor ligands,
2. To design, synthesize, and characterize various metal complex precursors,
3. To incorporate the newly synthesized functionalized phosphorus-containing ligands into selected metal centres and to characterize the metal complexes formed,
4. To investigate the spectroscopic, electronic absorption and electrochemical properties of the newly synthesized functionalized phosphorus-containing molecules, π-conjugated molecules and metal complexes,
5. To study the self-assembly behaviour, electronic communication and charge transport properties of these molecules and metal complexes,
6. To study the light-emitting (photoluminescence and electroluminescence) and light-harvesting behaviour of these functionalized molecules and metal complexes, and
7. To explore and assess the potential of these molecular materials and supramolecular assemblies for molecular electronics and optoelectronics for charge transport, OLEDs and OPVs and to establish their structure-property relationship.

5.2 Revised Objectives

Date of approval from the RGC: Not applicable.

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)

With the synergistic efforts of both the Hong Kong Team and the French Team, new classes of functionalized phosphorus-containing molecules, π-conjugated molecules and donor ligands, and their metal complexes have been designed and synthesized. Various functionalized phosphorus-containing molecules, π-conjugated molecules and donor ligands as well as metal complexes based on gold(I), copper(I), platinum(II) and gold(III) centres with interesting functional properties have been successfully designed and synthesized. Specifically, a new class of light-absorbing photochromic phenyl{2-[2-2'-5,5'-tetramethyl(3,2':3',3"-terthiophen)-5'-yl]phenyl}-phosphine oxides has been designed and synthesized by integrating the phosphole moiety in the

dithienylethene backbone. These compounds exhibit reversible photochromic behaviour with high photocyclization conversion efficiencies. Their photochromic, photophysical and electrochemical properties were shown to be readily modulated by functionalization at the phosphorus centre without tedious modification of the diarylethene framework [*Angew. Chem. Int. Ed.* **2013**, *52*, 11504–11508; *Chem. Eur. J.* **2015**, *21*, 6936-6948]. New classes of photochromic thieno[3,2,*b*]phosphole oxides have been shown to demonstrate photochromism as visible light photoswitches with excellent thermal irreversibility, robust fatigue resistance, rendering them promising candidates for potential applications of photoresponsive electronics [*J. Am. Chem. Soc.* **2017**, *139*, 15142–15150]. Photochromic benzo[*b*]phosphole oxides have been demonstrated to display photochromic properties with excellent fatigue resistance and thermal irreversibility in polymethylmethacrylate (PMMA) thin film under ambient conditions [*Chem. Sci.* **2017**, *8*, 1309–1315]. The introduction of phosphole oxide-containing alkynyl ligand into gold(III) complexes has given rise to light-absorbing and light-emitting charge-transfer active materials for the fabrication of solution-processable resistive ternary memories with distinct and low switching threshold voltages for the first time [*J. Am. Chem. Soc.* **2016**, *138*, 6368–6371]. The self-assembly behavior of the phosphorus-containing molecules and metal complexes have also been demonstrated. Notably, rich classes of luminescent mono-, di- and polynuclear gold(I) and copper(I) phosphine clusters have been constructed by supramolecular assembly with short aurophilic Au···Au and cuprophilic Cu···Cu interactions by the introduction of aminodiphosphines, vinylidenebis(diphenylphosphine), 1,1'-bis(diphenylphosphino)ferrocene (dppf), various di- and tri-phosphines and the chiral (2,2'-bis(diphenylphosphino)-1,1'-binaphthyl) (binap) to give rise to supramolecular clusters and nanoaggregate assemblies; some of them showed responsive structural transformation triggered by solvent, light and counter-ions. Luminescence color switching of supramolecular assemblies of discrete molecular gold(I) clusters was observed via intercluster supramolecular nanoaggregate assembly with different emission colours spanning from green to yellow to red and various nanostructured morphological transformation from the spherical shape to the cube that are dependent on the alkyl chain lengths and the solvent environment [*Proc. Natl. Acad. Sci. U.S.A.* **2014**, *111*, 15900–15905]. Heterochiral self-sorting and sequential self-assembly were observed for the first time in the chiral binap-gold clusters, which were highlighted in *JACS Spotlights* [*J. Am. Chem. Soc.* **2016**, *138*, 7260–7263; *J. Am. Chem. Soc.* **2016**, *138*, 7446–7447]. Diphosphine-stabilized ultrasmall gold nanoclusters with ligation-driven symmetry breaking and anion exchange properties have also been obtained [*J. Am. Chem. Soc.* **2016**, *138*, 15736-15742]. Introduction of large π-surface ligands also led to supramolecular assembly of luminescent alkynylgold(I) phospholes [*Chem. Commun.* **2014**, *50*, 13272-13274]. Luminescent copper(I) and gold(I) phosphines have also been synthesized and their luminescence behavior have been studied. The formation of Au···Au and Cu···Cu interactions not only has supported the high nuclearity structures of these clusters but also impart them with their rich luminescence properties [*J. Am. Chem. Soc.* **2014**, *136*, 10801–10806; *J. Am. Chem. Soc.* **2015**, *137*, 3506–3509; *Inorg. Chem.* **2014**, *53*, 3854-3863], with the Cu(I) system displaying thermally activated delayed fluorescence (TADF) properties [*Chem. Commun.* **2016**, *52*, 11370–11373]. This latter work on TADF properties of organophosphorus-containing Cu(I) molecular clips, platinum(II) and nickel(II) complexes fully demonstrates the powerfulness of our synergistic collaborative efforts with the Cu(I) clusters and the DFT studies contributed by the French Team and the photophysical TADF studies by the Hong Kong Team. Incorporation of the phosphole building block prepared by the French Team to the platinum(II) precursors prepared by the Hong Kong Team has also led to the successful preparation of new metallosupramolecular π-conjugated amphiphile which lead to the formation of self-assembled nanostructures *via* Pt···Pt, π–π stacking and hydrophobic–hydrophobic interactions under an isodesmic growth mechanism [*Chem. Sci.* **2017**, *8*, 4264–4273]. The light-emitting, light-harvesting, charge transfer, self-assembly and phosphorescent OLED and OPV properties based on phosphorus-containing π-conjugated molecules and metal complexes have also been explored [*Top. Curr. Chem.* **2016**, *374:46*, 1-43; *Chem. Rev.* **2015**, *115*, 7589-7728]. These have also led to a number of plenary, keynote and invited lectures at major international conferences as well as the training of 3 PhD students in The University of Hong Kong. The project has promoted the synergistic collaboration of the team in phosphorus-containing π-conjugated molecular materials research.

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

The exceptional performance of various novel classes of phosphorus-containing π-conjugated molecular functional materials obtained from this collaborative project has formed the basis and inspiration for new areas of development. Particularly, this project forms the basis for the design and synthesis of new functionalized phosphorus-containing molecules, π-conjugated molecules and metal complexes that are capable of aggregation, self-assembly and luminescence to serve as optically addressable functional materials and photoswitchable responsive materials. The collaboration has also brought together expertise and experience of both the Hong Kong Team and the French Team that are synergistic. This will form the basis for continued collaborative efforts. It also provides the fundamental understanding of functionalized phospholes, benzophospholes, dibenzophospholes, dithienophospholes, and bridging phosphine ligands as well as P-containing molecules and π-conjugated molecules functionalized with ligating groups for metal coordination that will have huge impact for the future design and the further development of phosphorus-containing functional materials. These are vital for the construction of novel classes of molecular materials that lead to the fundamental knowledge required for the future design and fabrication of molecular functional materials in ordered thin films and molecular electronic and optoelectronic devices. Additional functionalities with electron donor and acceptor properties, electro-active, charge transport functions, self-assembly and stimuli-responsive features could be introduced into the molecules for diverse applications. These would have important impact and potential for the future design and development of molecular functional materials and their supramolecular and structural properties. Beyond these scopes, the potential of selected molecular materials and supramolecular assemblies for molecular electronics and optoelectronics for charge transport, OLEDs, OPVs and organic memory devices could also be explored. Further work could also be made to establish their structure-property relationships. Collaborative links and closer interactions between the two groups will be invaluable for future research work in this area.

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)

A Hong Kong-French collaborative research team consisting of members from The University of Hong Kong and The Université de Rennes 1 with complementary expertise has been assembled. The project has led to the discovery of novel classes of phosphorus-containing π-conjugated molecular materials and assemblies with light-emitting, light-harvesting, photosensitizing, electronic communication, self-assembly, charge transport and photoswitching properties and have been successfully utilized for various molecular electronics and optoelectronics spanning from photochromic devices, self-assembly functional materials, self-sorting/self-healing polynuclear systems to optical and organic resistive memory applications. These phosphorus-containing π-conjugated molecular materials hold great promises in advancing the field of molecular materials research and have led to systems with unique optical, luminescence and electronic properties that have found potential applications as light-emitting and light-harvesting materials in molecular optoelectronics such as in OLEDs and OPVs, and as electronic communication and charge transport photoswitching and resistive switching materials in molecular electronics and memories. The team has disseminated new knowledge in the form of 30 publications in high impact peer-reviewed journals, training of PhD students, academic exchanges and closer ties between Hong Kong and France, keynote and invited lectures at major international conferences as well as prizes and awards for the team members. These should contribute not only to the advancement of knowledge, but also in promoting the synergistic collaborative research efforts of the team in molecular functional materials.

Part C: Research Output

8. Peer-reviewed journal publication(s) arising directly 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)*						
2013				Chan, J. C.-H.; Lam, W. H.; **Wong, H.-L.**; Wong, W.-T.; **Yam, V. W.-W.***	"Tunable Photochromism in Air-Stable, Robust Dithienylethene-Containing Phospholes through Modifications at the Phosphorus Center", *Angewandte Chemie International Edition* **2013**, *52*, 11504-11508.	Yes	Yes	Yes	Yes
2014				Siu, S. K.-L.; Ko, C.-C.; Au, V. K.-M; **Yam, V. W.-W.***	"Synthesis, Characterization and Photophysical Studies of Luminescent Dinuclear and Trinuclear Copper(I) Alkynyl Phosphines", *Journal of Cluster Science* **2014**, *25*, 287-300.	Yes	Yes	Yes	Yes
2014				Cheng, E. C.-C.; Lo, W.-Y.; Lee, T. K.-M.; Zhu, N.; **Yam, V. W.-W.***	"Synthesis, Characterization, and Luminescence Studies of Discrete Polynuclear Gold(I) Sulfido and Selenido Complexes with Intramolecular Aurophilic Contacts", *Inorganic Chemistry* **2014**, *53*, 3854-3863.	Yes	Yes	Yes	Yes

2014				Lo, H.-S.; Zhu, N.; Au, V. K.-M.; **Yam, V. W.-W.***	"Synthesis, Characterization, Photophysics and Electrochemistry of Polynuclear Copper(I) and Gold(I) Alkynyl Phosphine Complexes", *Polyhedron* **2014**, *83*, 178-184.	Yes	Yes	Yes	Yes
2014				Yao, L.-Y.; Hau, F. K.-W.; **Yam, V. W.-W.***	"Addition Reaction-Induced Cluster-to-Cluster Transformation: Controlled Self-Assembly of Luminescent Polynuclear Gold(I) μ_3-Sulfido Clusters", *Journal of the American Chemical Society* **2014**, *136*, 10801-10806.	Yes	Yes	Yes	Yes
2014				Hau, F. K.-W.; Lee, T. K.-M.; Cheng, E. C.-C.; Au, V. K.-M.; **Yam, V. W.-W.***	"Luminescence Color Switching of Supramolecular Assemblies of Discrete Molecular Decanuclear Gold(I) Sulfido Complexes", *Proceedings of the National Academy of Sciences of the United States of America* **2014**, *111*, 15900-15905.	Yes	Yes	Yes	Yes

2014				**Hong, E. Y.-H.; Wong, H.-L.; Yam, V. W.-W.***	"Tunable Self-Assembly Properties of Amphiphilic Phosphole Alkynyl-gold(I) Complexes through Variation of the Extent of the Aromatic π-Surface at the Alkynyl Moieties", *Chemical Communi-cations* **2014**, *50*, 13272-13274.	Yes	Yes	Yes	Yes
2015				Yao, L.-Y.; **Yam, V. W.-W.***	"Photoinduced Isomerization-Driven Structural Transformat-ion Between Decanuclear and Octadeca-nuclear Gold(I) Sulfido Clusters", *Journal of the American Chemical Society* **2015**, *137*, 3506-3509.	No	Yes	Yes	Yes
2015				Hung, L.-L.; Lam, W. H.; **Wong, K. M.-C.**; Cheng, E. C.-C.; Zhu, N.; **Yam, V. W.-W.***	"Synthesis, Luminescence and Electro-chemical Properties of Luminescent Dinuclear Mixed-Valence Gold Complexes with Alkynyl Bridges", *Inorganic Chemistry Frontiers* **2015**, *2*, 453-466.	No	Yes	Yes	Yes

2015				Chan, J. C.-H.; **Wong, H.-L.**; Wong, W.-T.; **Yam, V. W.-W.***	"Tunable Photochromism in the Robust Dithienylethene-Containing Phospholes: Design, Synthesis, Characterization, Electrochemistry, Photophysics, and Photochromic Studies", *Chemistry - A European Journal* **2015**, *21*, 6936-6948.	No	Yes	Yes	Yes
2015				He, X.M.; Lam, W. H.; Cheng, E. C.-C.; **Yam, V. W.-W.***	"Cleavage of a P-N Bond in a Urea-Containing ($Ph_2P(R)$-PPh_2)-Bridged Dinuclear Gold(I) Thiolate Complex by Fluoride and Mechanistic Insight", *Chemistry - A European Journal* **2015**, *21*, 447-8454.	No	Yes	Yes	Yes
2015				**Yam, V. W.-W.***; Au, V. K.-M.; **Leung, S. Y.-L.**	"Light-Emitting Self-Assembled Materials Based on d^8 and d^{10} Transition Metal Complexes", *Chemical Reviews* **2015**, *115*, 7589-7728.	No	Yes	Yes	Yes
2016				**Hong, E. Y.-H.**; Poon, C.-T.; **Yam, V. W.-W.***	"A Phosphole Oxide-Containing Organogold(III) Complex for Solution-Processable Resistive Memory Devices with Ternary Memory Performances", *Journal of the American Chemical Society* **2016**, *138*, 6368-6371.	No	Yes	Yes	Yes

2016				Yao, L.-Y.; Lee, T. K.-M.; **Yam, V. W.-W.***	"Thermo-dynamic-Driven Self-Assembly : Heterochiral Self-Sorting and Structural Recon-figuration in Gold(I)-Sulfido Cluster System", *Journal of the American Chemical Society* **2016**, *138*, 7260-7263.	No	Yes	Yes	Yes
2016				Lo, H.-S.; Cheng, E. C.-C.; Xu, H.-L.; Lam, W. H.; Zhu, N.; Au, V. K.-M.; **Yam, V. W.-W.***	"Synthesis, Characteri-zation, Photophysics and Electro-chemistry of Hexanuclear Silver(I) Alkynyl Phosphine Complexes", *Journal of Organo-metallic Chemistry* **2016**, *812*, 43-50.	No	Yes	Yes	Yes
2016				Tang, M.-C.; **Chan, A. K.-W.; Chan, M.-Y.; Yam, V. W.-W.**	"Platinum and Gold Complexes for OLEDs", *Topics in Current Chemistry* **2016**, *374*, 1-43.	No	Yes	Yes	Yes
2016				El Sayed Moussa, M.; Evariste, S.; **Wong, H.-L.**; Le Bras, L.; Roiland, C.; Le Polles, L.; **Le Guennic, B.; Costuas, K.*; Yam, V. W.-W.*; Lescop, C.***	"A Solid State Highly Emis-sive Cu(I) Metallacycle: Promotion of Cuprophilic Interactions at the Excited States", *Chemical Communi-cations* **2016**, *52*, 11370-11373.	No	Yes	Yes	Yes

2016				Yao, L.-Y.; **Yam, V. W.-W.***	"Diphosphine-Stabilized Small Gold Nanoclusters: From Crystal Structure Determination to Ligation-Driven Symmetry Breaking and Anion Exchange", *Journal of the American Chemical Society* **2016**, *138*, 15736-15742.	No	Yes	Yes	Yes
2016				Wu, N. M.-W.; **Wong, H.-L.; Yam, V. W.-W.***	"Photochromic Benzo[b]-phosphole Oxide with Excellent Thermal Irreversibility and Fatigue Resistance in the Thin Film Solid State via Direct Attachment of Dithienyl Units to the Weakly Aromatic Heterocycle", *Chemical Science* **2017**, *8*, 1309-1315.	No	Yes	Yes	Yes
2017				**Leung, S. Y.-L.**; Evariste, S.; **Lescop, C.; Hissler, M.*; Yam, V. W.-W.***	"Supramolecular Assembly of a Phosphole-based Moiety into Nanostructures Dictated by Alkynylplatinum(II) Terpyridine Complexes through Non-covalent Pt-Pt and π–π Stacking Interactions: Synthesis, Characterization, Photophysics and Self-assembly Behaviors", *Chemical Science* **2017**, *8*, 4264-4273.	No	Yes	Yes	Yes

2017				Wu, N. M.-W.; Ng, M; Lam, W. H.; **Wong, H.-L.**; **Yam, V. W.-W.***	"Photochromic Heterocycle Fused Thieno[*3,2-b*] phosphole Oxides As Visible Light Switches Without Sacrificing Photoswitching Efficiency", *Journal of the American Chemical Society* **2017**, *139*, 15142-15150.	No	Yes	Yes	Yes
2014				El-Sayed Moussa, M.; Guillois, K.; Shen, W.; Réau, R.; Crassous, J.*; **Lescop, C.***	"Dissymmetrical U-shape π-Stacked Supramolecular Assemblies using a Dinuclear Cu^{I} Clip bearing Organophosphorus Ligands and Monotopic Fully π-Conjugated Ligands", *Chemistry, a European Journal* **2014**, *20*, 14853-14867.	No	Yes	Yes	No
2015				Riobé,F.; Szűcs, R.; Bouit, P.-A.; Tondelier, D.; Geffroy, B.; Aparicio, F.; Buendía, J.; Sánchez, L.; Réau, R.; Nyulászi, L.*; **Hissler, M.***	"Synthesis, Electronic Properties and WOLED Devices of Planar Phosphorus-containing Polycyclic Aromatic Hydrocarbons", *Chemistry, a European Journal* **2015**, *21*, 6547-6556.	No	Yes	Yes	No

2015				Shen, W.; El-Sayed Moussa, M.; Yao, Y.; **Lescop, C.***	"Supramolecular Metallacycles with a 'Pseudo Double-Paracyclophane' Structure based on Flexible π-Conjugated Linkers", *Chemical Communications* **2015**, *51*, 11560-11563.	No	Yes	Yes	No
2016				Delaunay, W.; Szucs, R.; Pascal, S.; Mocanu, A.; Bouit, P.-A.; Nyulaszi, L.*; **Hissler, M.***	"Synthesis and Electronic Properties of Polycyclic Aromatic Hydrocarbons doped with Phosphorus and Sulfur", *Dalton Transaction* **2016**, *45*, 1896–1903.	No	Yes	Yes	No
2016				Joly, D.; Bouit, P.-A.; **Hissler, M.***	"Organophosphorus derivatives for electronic devices", *Journal of Materials Chemistry C* **2016**, *4*, 3686-3698.	No	Yes	Yes	No
2016				Duffy, M. D.; Delaunay, W.; Bouit, P.-A.; **Hissler, M.***	"π-Conjugated Phospholes and their Incorporation into Devices; A Component with a Great Deal of Potential", *Chemical Society Review* **2016**, *45*, 5296-5310.	No	Yes	Yes	No
2017				Riobé, F.; Szücs, R.; **Lescop, C.**; Réau, R.; Nyulászi, L.*; Bouit, P.-A.*; **Hissler, M.***	"Coordination complexes of P-containing Polycyclic Aromatic Hydrocarbons: Optical Properties and Solid-state Supramolecular Assembly", *Organometallics* **2017**, *36*, 2502-2511.	No	Yes	Yes	No

2017				**Lescop, C.***	"Coordination-Driven Syntheses of Compact Supramolecular Metallacycles toward Extended Metallo-organic Stacked Supramolecular Assemblies", *Accounts of Chemical Research* **2017**, *50*, 885-894.	No	Yes	Yes	No
2018				El-Sayed Moussa, M.; Evariste, S.; Kramer, B.; Réau, R.; Scheer, M.* ; **Lescop, C.***	"Can Coordination-Driven Supramolecular Self-Assembly Reactions Be Conducted from Fully Aliphatic Linkers ? ", *Angewandte Chemie* **2018**, *130*, 803-807.	No	Yes	Yes	No

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)*
May 2014 Dublin, Ireland	**Yam, V.W.W.**, "From Discrete Metal- Ligand Chromophoric Complexes To Supramolecular Assemblies and Nanostructures" (Plenary Lecture)	2014 International Strategic Collaboration Programme (ISCP) Ireland China Nanotechnology Conference	Yes	Yes	Yes (at the meeting)	No
July 2014 Sapporo, Japan	**Yam, V.W.W.**, "From Organometallics To Photofunctional Materials" (Plenary Lecture)	26th International Conference on Organometallic Chemistry (ICOMC2014)	Yes	Yes	Yes (at the meeting)	No

July 2014 Singapore	**Yam, V.W.W.,** "Versatile Metal-Ligand Chromophoric Building Blocks – From Simple Discrete Metal Complexes To Supramolecular Assembly and Sensory Functions" (Plenary Lecture)	41st International Conference on Coordination Chemistry (ICCC-41)	Yes	Yes	Yes (at the meeting)	No
June 2017 Vancouver	**Yam, V.W.W.,** "Heteroatom-Containing Coordination Motifs and π-Conjugated Molecules as Versatile Building Blocks for Molecular Functional Materials" (Plenary Lecture)	12th International Conference on Heteroatom Chemistry (ICHAC-12)	No	Yes	Yes (at the meeting)	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
Jacky Chi-Hung CHAN	Ph.D.	01/09/2009	25/02/2014 (graduation)
Eugene Yau-Hin HONG	Ph.D.	01/09/2010	24/07/2015 (graduation)
Liaoyuan YAO	Ph.D.	01/09/2012	11/01/2017 (graduation)

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

The collaborative project has led to much stronger ties, strategic alliance and friendship between the Hong Kong team and the French team of complementary expertise and the joint supervision and training of Ph.D. students and Postdoctoral Fellows during their exchange visits. The team members together with graduate students and postdoctoral fellows have the precious opportunities to gain exposure to new research ideas, techniques and environment. The outcome of the project has led to a number of plenary/session/invited lectures at international conferences. In addition, frequent exchange visits and the organization of the ANR-RGC Mid-Term Workshop have been held in The University of Hong Kong on 28 Nov 2014 to facilitate fruitful collaborative research and team discussions. The details of visits and exchange activities as well as the scientific programme for the ANR-RGC Mid-Term Workshop are included in the Appendices I and II.

Please see attached.