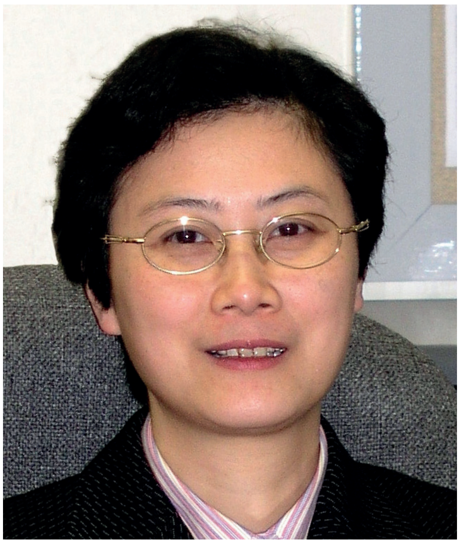
CELEBRATING A CENTURY OF HKU'S RESEARCH EXCELLENCE AND BEYOND

AN INTERVIEW WITH PROFESSOR YAM, VIVIAN WING WAH

Professor Vivian Yam Wing-Wah is the Philip Wong Wilson Wong Professor in Chemistry and Energy, and Chair Professor of Chemistry at The University of Hong Kong (HKU). Professor Yam's main area of research is in inorganic / organometallic syntheses and photochemistry related to luminescence and solar energy conversion. The major focus is on the molecular design and synthesis of novel inorganic and organometallic metal complexes that may find potential applications as functional metal-based molecular materials. Professor Yam's seminal works on luminescent polynuclear metal complexes and clusters, and light-emitting carbon-rich organometallics have gained her international recognition, including the 2011 L'Oréal-UNESCO Women in Science Awards. Professor Yam is also the winner of the HKU Distinguished Research Achievement Award (DRAA), 2006-2007 and HKU Outstanding Research Award (ORA) Winner.



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1. Could you please share with us briefly about your key research areas?

My key research areas include synthetic inorganic/organometallic chemistry, supramolecular chemistry, photochemistry, solar energy conversion, and functional metal-based molecular materials, especially those involving the molecular design and synthesis of new classes of luminescent and chromophoric metal complexes and functional molecules and the investigation of their luminescence and excited state properties. Of particular interests are luminescent carbon-rich metal alkynyls, polynuclear metal complexes and metal chalcogen clusters, and the supramolecular chemistry and assembly of metal complexes using non-covalent metal-metal and π-π stacking interactions. Apart from utilizing these non-covalent interactions for directed supramolecular assembly and stabilization of supramolecular nanostructures and organogels, exploitation of the unique spectroscopic and luminescence properties associated with non-covalent metal-metal interactions of gold(I) and platinum(II) as spectroscopic reporters and probes of assembly and disassembly processes and as chemosensors and biosensors of molecular recognition and aggregation phenomenon has also been one of the major research directions in our group. The discovery of novel chromophoric and luminescent metal-based materials with tunable absorption and emission colours, excited-state and redox properties and their fundamental spectroscopic study are believed to lay the foundation for development of new classes of solar-energy storage materials for organic photovoltaics and solar fuels as well as phosphorescent materials for organic light emitting diode (OLED) displays and white organic light-emitting diode (WOLED) solid-state lighting that are relevant to energy research.

2. How did you become involved in this research, were there any challenges encountered along the way and what motivates you to continue in these areas of research?

Inspired by nature, there has been a long standing interest in the development of molecular materials that can perform a function or task. A number of functional properties and behavior in biology and in materials depend on the fine interplay of supramolecular non-covalent interactions beyond those of the molecule. Trained as an inorganic and coordination chemist, I am particularly interested in the discovery of new classes of luminescent and chromophoric molecular materials and metal complexes and the understanding of their excited state and charge transport properties. With the growing worldwide concern in energy and environmental-related issues, extension of the work to develop new classes of triplet emitters or phosphors for efficient phosphorescent OLEDs and efficient light-harvesting chromophores for solar energy conversion and organic photovoltaics represent a major challenge. These new classes of luminescent and chromophoric molecular materials and metal complexes can also be functionalized as luminescence and colorimetric probes for the sensing of molecules and ions of biological and environmental interest. Moreover, the fundamental understanding and control of orientation and assembly of molecules and metal complexes based on supramolecular non-covalent interactions are important to the ultimate performance and functionality of the material and sensor properties. This era is an exciting time when interdisciplinary efforts are required to tackle important scientific problems and challenges and as a chemist, we have ample opportunities to work at the interface of chemistry, physics and engineering on materials and energy related issues and at the interface of chemistry, biology and medicine on health related issues.

3. Why do you think your research papers have been highly cited?

While non-covalent metal-metal interactions involving metal centers of d^8 and d^{10} electronic configuration are known and can give rise to unique colors and spectroscopic properties, they are mostly observed in the solid state. With the incorporation of strong electron-donating ligands, we are able to prepare new classes of luminescent metal complexes that show strong phosphorescence in solution at room temperature; and through the functionalization with solubilizing groups, unique aggregation phenomenon involving the supramolecular assembly of metal complexes via non-covalent metal-metal interactions that gives rise to drastic color and luminescence changes has been rendered observable in solution. These unique spectroscopic changes have provided the necessary information for the understanding and experimental quantification of these supramolecular non-covalent interactions. Utilization of these non-covalent metal-metal interactions for directed supramolecular assembly of clusters and metallamacrocycles as well as for the stabilization of supramolecular nanostructures and organogels has been demonstrated. These studies have provided an understanding of the structure-property relationship and a direct correlation of the strength of these non-covalent interactions to the stability of the supramolecular organogels. Exploitation of the unique spectroscopic features of these supramolecular non-covalent metal-metal interactions for the label-free sensing of molecules and ions of biological and environmental interest has also been demonstrated.

4. Do they usually describe a new discovery, methodology, or synthesis of knowledge? Could you summarize the significance of your papers in layman's terms?

New classes of molecular functional materials are discovered and interesting spectroscopic properties associated with self-assembly and aggregation phenomenon are also revealed. Unlike the conventional approach of performing chemical modification on the molecules to achieve tunability of various spectroscopic and physical properties, the use of supramolecular control and assembly involving metal-metal interactions to tune the spectroscopic, excited state, structural and morphological properties of molecular materials represent an innovative approach. Exploitation of these non-covalent interactions to direct the construction of supramolecular assemblies and for use as spectroscopic probes have been demonstrated.

5. What outcomes or impact on society do you hope to see as a result of your research? Where do you see your research heading in the future?

Development of new classes of efficient chromophores and luminophores and the supramolecular control of molecular assembly will have important impact and contribution towards our society in addressing not only the energy issue by laying the foundation for development of new classes of solar-energy storage materials for organic photovoltaics and solar fuels as well as phosphorescent materials for organic light emitting diode (OLED) displays and white organic light-emitting diode (WOLED) solid-state lighting that are relevant to energy research, but also new classes of molecular functional materials as well as colorimetric and luminescence sensors for biomedical and environmental applications.