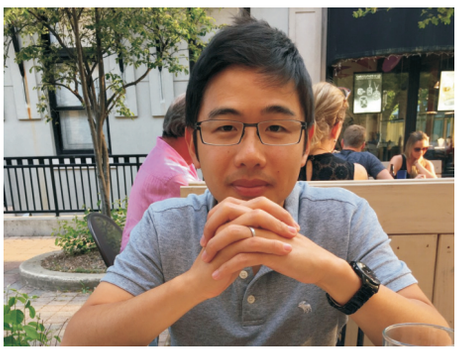

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主要研究領域

本研究室為"先進催化材料和無碳能源研究室"，研究的核心主題為"燃料電池及水分解電極觸媒開發"、" 氣相電化學催化反應觸媒開發"、和" 原位即時的材料研究"。

- **燃料電池及水分解電極觸媒開發**

  高分子電解質薄膜或質子交換薄膜的氫燃料電池擁有高度潛力成為下一代汽機車的動力來源。這種潔淨的能源技術在現階段，仰賴著昂貴的鉑金屬觸媒來催化電極反應，特別是陰極的氧氣還原反應。本研究室致力於低鉑載量的電極開發 (陰極<0.1 mg/cm^2; 陽極<0.025 mg/cm^2)，研發出具高效能並超長效的電極觸媒，為燃料電池的產業/商品化做出貢獻。利用同樣的組件，本研究室欲同時開發水分解的陽極觸媒。我們將著眼於研究穩性高的導體氧化物，致力於尋找能有效描述觸媒活性和穩定性的關鍵物理化學性質。

- **氣相電化學催化反應及觸媒開發**

  上述薄膜電極的設計同時也是一個進行氣相電化學反應的理想平台，這些反應包括二氧化碳的選擇性還原、氮氣加氫氣的氨氣合成、甲烷的脫氫反應等等。本研究室將會利用這個平台，研發各種重要氣相反應的觸媒，致力於推進上述各反應的效能和選擇性。

- **原位即時的材料研究**

  不論是在電池、催化、或其他重要的應用領域，材料在操作環境下的穩定性都決定該項科技的實際發展潛力。為了能更詳細的了解材料在運作時失活或失能的過程和基理，原位且即時的觀察扮演了相當重要的角色。本研究室計畫運用高解析度的透射電子顯微鏡和同步輻射中心的高能X光來進行材料穩定性研究。

Main Research Interests

The core theme of our research laboratory is developing advanced catalytic materials for a CO_2 free energy economy. To be more specific, we currently focus on electrode catalyst materials for polymer electrolyte membrane fuel cells (PEMFC), PEM water electrolysers, gas phase electrochemical conversion reactions such as CO_2 reduction, and "*in-situ*" "*operando*" studies of these catalytic materials.

- **Fuel Cell Electrode Catalyst**

  PEM fuel cell shows great potential to serve as the energy source for next generation moving vehicles. This carbon-free clean energy however, relies heavily on precious platinum (Pt) metal as its electrode catalyst, especially for the cathode oxygen reduction reaction (ORR). Our lab focus on developing low Pt loading electrodes (cathode: <0.1 mg/cm^2; anode: <0.025 mg/cm^2) that meet and exceed US-DOE targets. The developed catalysts and electrodes should be both very active, i.e., possessing very high power density under the heat rejection limit potential, and durable after extended periods of operation. Hopefully, through our research, we can expedite the schedule of putting such technologies on the market, making it economically competitive. In addition, we plan to use the system to develop catalyst materials for water electrolysers specifically on oxygen evolution reaction (OER). We will focus on stable conducting oxide materials and hopefully, unravel the key "descriptors" for high activity and durability.

- **Gas Phase Electrochemical Reactions and its Catalyst**

  The aforementioned platform is also very ideal for studying other gas phase electrochemical reactions, including electrochemical driven CO_2 reduction, ammonia synthesis from nitrogen and hydrogen, C-C coupling and dehydrogenation of methane, etc. We aim to apply this platform to study catalyst materials for these reactions targeting high energy efficiency and selectivity.

- **In-Situ Operando Study of Energy Materials**

  Stability of materials plays a crucial role in batteries, catalysis, solar cells, and other industrially important energy conversion applications. *In-Situ* Operando platforms are critical in performing detail investigations, with high temporal and spatial resolution, to unravel the degradation process of materials under working conditions. In the near future, we plan to utilize high resolution transmission electron microscopy (HRTEM) with dedicated in-situ holders as well as synchrotron based X-ray photoelectron spectroscopy (XPS) to carry out durability studies on important energy materials.

代表作 (Selected Publications)

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