國立清華大學第 6 屆傑出產學研究獎得獎人簡介

清華大學物理系高頻電磁實驗室主要研究工作是發展高功率、頻率可調、毫米波與兆赫波源。為了發展波源我們必須了解如何產生、激發與控制電磁場，也因此有很多國內、外相關專利與技術。我們逐漸發展出控制大面積與均勻電磁場的能力，而這能力可以用在大面積電漿產生；大面積微波材料處理；大面積微波食品乾燥與熱處理。甚至，大面積均勻微波場在化工產業/循環經濟上之關鍵技術。

高功率鐵氧體元件非常昂貴且經常受限於出口管制。我們對材料電磁特性的深入了解，使得我們是國內、外少數具有燒結、量測、設計與製造鐵氧體微波元件的團隊。利用鐵氧體，我們發展出移相器與快速切換技術。另外，在通訊產業上，我們也發展出環行器與隔離器。目前的環行器產品，其頻寬特性上媲美國際一流大廠。

微波可有效促進材料反應速率、縮短反應時間。在碳纖維製程中微波可大大縮短原絲的氧化時間。我們亦可精準量測碳纖維材料之微波特性，據此發展微波碳纖維技術。在微波生質柴油製程上，實驗顯示微波可加速生質柴油生產，降低作用溫度與成本。透過精確控制微波場，找出適合的電磁場以加速熱反應，減少製程時間。

另外，實驗室學生積極創業。目前已成立兩家公司：創蘊股份有限公司與焙焙有限公司。前者獲得全國創業競賽第一名與科技部創業傑出獎榮譽，並獲得多家創投的注目。後者利用微波處理咖啡豆，耗時短、加熱均勻，且能完整地激發咖啡的香味。目前有多位學生參與，目標是明年開始量產機台。在儀器與關鍵設備發展上，我們也拿到 2018 國研盃儀器科技創新獎第二名。

我們可以精確量測材料之介電與導磁特性；控制電磁場與陶瓷、磁性、甚至金屬材料熱處理。放眼未來，有很大的產業應用空間。

The main research work of the High Frequency Electrodynamics Laboratory of the Department of Physics of Tsing Hua University is to develop high-power, frequency-tunable, millimeter-wave to terahertz-wave sources. In order to develop wave sources, we must understand how to generate and control electromagnetic fields. Therefore, we hold many domestic and foreign patents related to those technologies. We than developed the ability to control large-area and uniform electromagnetic fields, which can be used in plasma production; microwave material processing; microwave food drying and heat treatment. Besides, the large-area uniform microwave plays a key technology in the chemical industry/circular economy.

High-power ferrite components are very expensive and often subject to export controls. Our in-depth understanding of the electromagnetic properties of materials has made us a team with sintering, measuring, designing and manufacturing microwave/ferrite components. Using ferrites, we have developed phase shifters and high-speed switching techniques. In addition, in the communications industry, we have also developed circulators and isolators. The current circulator products are comparable in terms of bandwidth characteristics to world-class manufacturers.

Microwave can effectively facilitate the material reaction rate and shorten the reaction time. The microwave can greatly shorten the oxidation time of the raw silk in the carbon fiber process. We can also accurately measure the microwave characteristics of carbon fiber materials and develop microwave carbon fiber technology accordingly. In the microwave biodiesel process, experiments show that microwave can accelerate the production of biodiesel and reduce the process temperature and cost. By precisely controlling the microwave field, we can find a suitable electromagnetic field to accelerate the thermal reaction and reduce the process time.

In addition, laboratory students are actively entrepreneurs. Two companies have been established: Chuang-yun Co., Ltd. and Baking Co., Ltd. The former won the first place in the National Entrepreneurship Competition and the Honorary Excellence Award of the Ministry of Science and Technology, and won the attention of many venture capitalists. The latter uses microwave to treat coffee beans, which is short in time, uniform in heating, and can completely stimulate the aroma of coffee. The goal is to start mass-production machines next year. In the development of instruments and key equipment, we also won the second place in the 2018 National Research Cup Instrument Technology Innovation Award.

We can accurately measure the dielectric and magnetic properties of materials; control electromagnetic fields and heat treatment of ceramic, magnetic, and even metal materials. Looking to the future, there is a lot of industrial application space.