

Professor Richard K Chang

A Lifelong Teacher and Friend



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Memories of Richard K. Chang

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Prologue

We came to know Richard as early as 1998, not by personal contact but through his research work on microcavities. It was almost 3 years later when we finally met each other. We still remember vividly numerous interesting conversations with him. During our interactions with Richard, which lasted for many years, our *perceptions* on academic careers and personal lives were deeply impacted. We are indebted to his valuable advice, generosity, and support.

Professional Interactions with Richard and Career Impact

Our professional interaction with Richard first started through the book he edited entitled “Optical Processes in Microcavities”.¹ We started to work in 1994 on III-nitride wide bandgap semiconductors, while we were at Kansas State University (KSU). It was a very exciting time. The III-nitride field just had several breakthroughs, which ultimately led to the *Nobel Prize in Physics* awarded jointly to Isamu Akasaki, Hiroshi Amano, and Shuji Nakamura in 2014.

As newcomers, we wanted to work on novel topics which had not been studied in material systems from which we may make an impact to the field. We decided to fabricate and study various microstructured photonic devices. One type of microcavity structures we studied was III-nitride microsize pyramids. We observed very complicated optical modes which we had difficulties to understand. We dug through literature in the field of microcavity. Naturally, we found the book edited by Richard. With what we learned from the materials in this book and in other literature, we eventually understood that a micropyramid can be treated essentially as a triangular microcavity, based on which an optical ray tracing method was developed for calculating the optical resonant modes inside the pyramidal microcavities and the calculation results agreed perfectly with those experimentally observed in GaN micropyramids. We believe this is just one example illustrating how researchers in other disciplines benefited from Prof. Chang’s seminal

¹Optical Processes in Microcavities (Advanced Series in Applied Physics) by Richard K. Chang (Editor) and Anthony J. Campillo (Editor), World Scientific Press, Singapore (1996).

works in microcavities. Likewise, we believe that many other people and *new generation of researchers working in related fields* will benefit from his contributions.

We met Richard for the first time around 2001 during one of the meetings under the program of Semiconductor Ultraviolet Optical Sources (SUVOS) funded by the Defense Advanced Research Projects Agency (DARPA). At that time, several politicians in the US Congress and news media members received anthrax spores through the US mail and this caused a big disturbance in society. The SUVOS program aimed to develop compact UV light emitters emitting around 280 nm, to be deployed to detect possible biological agents in the form of aerosol particles. Through this program, we overlapped and had common interests to develop a biological agent detection system. While Richard was focused on handling optical properties of bio-aerosol particles under a UV light source excitation, our interest was to develop a portable UV light source based on Al-rich AlGa_N and study the optical, electrical, and optoelectronic properties of nitride semiconductors and devices. We enjoyed and benefited from many fruitful exchanges with Richard.

During one of these professional meetings, the two of us met together with Richard and Prof. J.J. Song of Oklahoma State University. Prof. Song was very well respected in the nitride semiconductor community. During our conversation, we learned that Richard was her Ph.D. thesis advisor. We mentioned to Richard that Prof. Song's research group was the first to achieve optically pumped lasing in GaN materials, which was very exciting news in the nitride semiconductor community because GaN blue laser diodes had not been demonstrated back then. Richard was very proud of the achievements of his former student and conveyed congratulations to Prof. Song.

After our successful completion of III-nitride microcavity work, we wondered what new features a micro-sized blue/green LED would possess. This curiosity led to our invention of microLED technology in 2000. Presently, microLED is recognized as the ultimate display technology. The invention of microLEDs laid the foundation for many emerging applications, which currently are under intensive pursuits by almost all the big names in the tech industry for applications in flat-panel displays, smart watches, smart phones, i-glasses, dashboard projectors, and picoprojectors, 3D, augmented reality (AR), and virtual reality (VR) displays. Our invention of microLED and microdisplays has also significantly enhanced our reputation in the field and is our most proud career achievement. Looking back, without our initial pursuits in the microcavity research, the invention of microLED would probably not have been realized.

Professional Support from Richard

We are one generation younger than Richard both in academic career and personal life. Richard was also an endowed professor in a top university. During the period of our interactions, we were young and very energetic, while he had experience and wisdom. Our professional relationship evolved naturally into his guiding and helping both of us grow in all aspects. He was very generous to us and was willing to help us whenever possible. As one example, Hongxing was recommended by his colleagues to be considered for the

award of the university distinguished professor (UDP) title by KSU. Since the title of UDP represents the highest honor KSU can bestow on its faculty, the group consists of only a small number of about 25 faculty in the university. Hongxing provided Richard's name as one of the external references when requested by the nomination committee. Hongxing was awarded the title of UDP by KSU in the fall of 2004, thanks to the generous support of pioneers in the field, including Richard.

We also benefited greatly from Richard's valuable advice regarding how to deal with rejections. The career of a university professor is very competitive, particularly in the early stages. One must take responsibilities for teaching, research, publications, and secure funding. Often, many proposal applications submitted by new professors are rejected. One also receives reviewers' reports for one's submitted manuscripts, occasionally comprising quite discouraging comments. The rejections could lead to self-doubt. We were wondering from time to time, if we received more negative comments than others because we were at a less prestigious state university. We asked Richard for his thoughts and advice on how to deal with negative comments/rejections. Richard told us a story regarding one of his papers receiving very negative comments from a reviewer about the understanding of optical processes in microcavities, even though Richard was a pioneer and laid the foundation for the field of microcavity. He advised us only to focus on the most important issues and positive outcomes. His personal experiences helped us gain a better understanding of the academic environment and to establish confidence in our own abilities. His advice also helped us in many ways in choosing and carrying out difficult research projects with genuine impact as well as in the advancement of our careers. He inspired us to focus on what we want and love to do instead of being distracted by some negative comments and criticism.

We are now at the same age as Richard's, when we first met him. We remember all the help and support we received from Richard and other friends and colleagues. We learned from Richard and other generous senior colleagues: we also try to carry on their generousities to next generations — to help young faculty in whatever way we can. We have been promoting and writing many supportive letters for young people seeking jobs and/or career advancements, including promotion and obtaining fellowships in professional societies. Another example is our willingness to share our laboratory facilities to support younger researchers since our laboratories are equipped with some unique capabilities.

Several groups including Columbia University, General Electric (GE), National Air and Space Agency (NASA), Corning Inc., Applied Materials Inc., University of Wisconsin, and Dartmouth College have sent either graduate students or researchers to our laboratory to use our material growth, laser liftoff (LLO), and device fabrication and characterization facilities. In return, we gained satisfaction from the process of helping others. For example, we are so delighted to hear just recently that our Alrich AlGaIn deep UV materials grown for NASA are currently used by a NASA Jet Propulsion Laboratory (JPL) team to search for organic matter and minerals on Mars. As has been said "generosity pays off in *the* long run." In this sense, the DNA of generosity from Richard has been passed on.

Personal Interaction and Friendship with Richard

For many years, we also enjoyed a personal friendship with Richard. He provided much wisdom for our personal life throughout this period. Other than research, we found we had quite a lot of other topics in common. One of the reasons, looking back, maybe our backgrounds have certain similarities. We could talk smoothly switching between English and Chinese. He spent his childhood in China and knew traditional Chinese culture better than us in many aspects. We told him stories about our upbringings in China.

We invited Richard, around 2003, to give a colloquium for the students and faculty in the Physics Department at KSU. He visited many labs in the department and delivered a very interesting talk about his work on optical scattering of liquid droplets. He was very excited talking about his research. However, he was not a person, who only likes to talk about himself. He asked many intriguing questions about our research projects. It was probably too much energy drain with all the interactions and lab visits due to his health condition. After lunch, he said that “I need to put down my head just for a few minutes.” He stayed in Hongxing’s office and took a short break for about 15 minutes and then he appeared refreshed and energetic again.

We remember well one thing that Richard had mentioned that affected our careers later. Richard mentioned that it would be difficult to move one’s lab when one gets close to 55 years old. When an opportunity to relocate to Texas Tech University (TTU) in 2007, when we were both nearly 50, was offered to us, Richard’s earlier advice resonated with us and helped us make the final decision to move.

Our relationship became more personal after his visit to KSU. He told us that he had been diagnosed of Parkinson’s disease a few years ago. It may have been caused by his overuse of dichlorodiphenyltrichloroethane (DDT) to kill mosquitoes, when he was a teenager living in Brazil. He said he had such a good time observing the mosquitoes diving down under the spray of DDT, but never knew back then this could come back to hurt him. We talked about the fact that the Nobel Prize in Physiology or Medicine 1948 was awarded to Paul Hermann Müller “for his discovery of the high efficiency of DDT as a contact poison against several arthropods,” and then the US banned DDT in 1972, and it was banned completely in 2001 internationally. We then told ourselves that this is an example illustrating that even a Nobel Prize discovery needs to stand the *test of time*.

During his visit to KSU, he gave us a surprise gift — a book written by his daughter, Pang-Mei Natasha Chang. The title of the book is very interesting to us, “*Bound Feet & Western Dress: A Memoir* (小脚与西服).” The copy he gave to us has been translated into Chinese. As described by the introduction of the book, “In this exquisite memoir, Chang Yu-Yi (張幼儀), the daughter of a distinguished Chinese family, recreates her life for her American-born grandniece, Pang-Mei Natasha Chang, a Harvard student who is conflicted about her identity.” Most Chinese of Richard’s generation who got advanced education in the US were associated with privileged families in China. The book recounts the facts revolving around the marriage and the divorce between Chang Yu-Yi and her ex-husband, Zhi-Mo Xu (徐志摩). Zhi-Mo Xu is considered to be one of the most important

figures of modern Chinese poetry and his divorce from Chang Yu-Yi was the first of its kind in the history of modern China. Almost every Chinese knows the name of Zhi-Mo Xu and considered this divorce event as a courageous rejection to an old feudal Chinese tradition by a talented modern poet. Moreover, as we grew up in China, our brains were filled with the stories of Zhi-Mo Xu's romantic love affairs with Huiyin Lin (林徽音) and Xiaoman Lu (陆小曼) and never bothered to ask what had happened to Chang Yu-Yi at the end. Richard told us that the main character in the book (Chang Yu-Yi) is his aunt. As we read through the book, we were so shocked to learn that his aunt continued to take care of her ex-in-laws, raised her son, and even provided financial support to Xiaoman Lu during Lu's *toughest* years. Most impressively, she eventually became a highly respected CEO of a fashion company and a successful banker. It is a fascinating story still being discussed widely and continue to be "discovered" by the younger generations on the internet today. Pang-Mei Chang's book really helped people, especially those who grew up in China, to know the facts and understand better about the history and culture of China during the early 20th century.

We had a long discussion during the dinner around this topic. We guessed that the reason Richard gave us this book as a gift probably was not only because his daughter was the author, but it also revealed the history of his family. From the book, we also learned that Pang-Mei Natasha was requested by members of the old generation of the Chang family to show mercy for Zhi-Mo Xu, while she was preparing to write this book, despite the fact that Zhi-Mo Xu had brought an enormous amount of pain to Chang Yu-Yi, his own son, and the Chang family. This speaks volumes of the character of extraordinary decency of the Chang family. Richard told us how his daughters got interested in Chinese culture and how Richard and Sunny educated their children. We were very impressed with the fact that all their three children graduated from Harvard University.

Around spring of 2003, we took our oldest son to visit several university campuses to prepare for his college applications, including Yale University. Richard was very generous and arranged our visit. When we checked into hotel, we were surprised that the room had been paid for. When we asked him, he said "I have some extra funds to cover visits from collaborators." We were not quite sure what he meant. Many years later, as we became endowed chair professors after being recruited by Texas Tech University, we realized that he used his endowment fund to cover the hotel room expenses for us. This was another example of Richard's generosity and thoughtfulness. Not only did we get a chance to visit the campus, but we also visited Richard's lab and spent many hours with him. After we visited the Yale campus, we were surprised and delighted that Richard invited us to visit his vacation house or retirement-to-be house in Brattleboro, Vermont, which is about a 2 hour's drive from Yale University. We talked about children's education, and he also talked about his retirement plan. His vacation house is beautiful and sits right on the bank of a river. He told us that he loved diving and swimming. We also met for the first time Richard's wife, Sunny, in their vacation house. She was also so generous and prepared a lovely dinner for all of us. Richard and Sunny kindly invited us to visit anytime if we happen to be in the east coast of US. It was such a pleasant visit and one which we will never forget.

Looking back, we regretted that we did not keep up personal contact with Richard after around 2008 because of two events that occurred. Richard was retired in 2008 and naturally our professional interactions reduced. At the same time, we were recruited by TTU. With changes in email addresses and all the hectic days involved in lab moving and settling down in a new place, we lost contact with Richard. However, we did hear about Richard from our common colleagues. Prof. Mark Reed, Richard's colleague at Yale University, visited us at TTU in 2012. Prof. Mark Reed and we shared the same PhD advisor, Prof. Arnold Honig, at Syracuse University. He told us that Richard had an accident, while swimming in a pool near their retirement house. After that, we also met with Prof. Jun Han, another one of Richard's colleagues at Yale University, during a nitride semiconductor meeting and we were relieved to hear from Jun that Richard had recovered from the previous near drowning episode.

Prof. Richard Chang's contributions to science, his wisdom and generosity will always be remembered. His legacy will live on in a *new generation of researchers* who will continue to benefit from his work and seminal contributions. We miss him dearly.

Editors' note:

Pang-Mei Chang, *Bound Feet and Western Dress: A Memoir*, 215 pages, Anchor (1997).