

## An-Pang Tsai (1958–2019)

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Figure 1

An-Pang Tsai presenting his Keynote Lecture *Quasicrystals: structures, properties and applications* at the IUCr Congress and General Assembly in 2008.

An-Pang Tsai, Professor at Tohoku University, Sendai, Japan, passed away on May 25 2019 at the age of 60. He was a pioneer and a leader in the field of quasicrystals and complex intermetallic phases. With him the community has lost one of the brightest scientists in this field.

An-Pang Tsai was born in Taiwan in 1958. He graduated from the Department of Mining and Metallurgical Engineering, Provincial Taipei Institute of Technology (now National Technical University of Taipei) in 1979. After a few years working for the Taiwan Honda company, he moved with his wife to

Akita, Japan, and in 1985 received a bachelor degree from the Department of Metallurgy of Akita University. He then moved to the Department of Metallurgy of the Faculty of Engineering of Tohoku University in Sendai where he was awarded a Master of Engineering degree in 1987 and then a doctorate degree in 1990. He undertook his master thesis and his PhD research under the supervision of Professor Masumoto starting on the study of metallic glasses, their synthesis and mechanical properties. During this period he also made one of the most important discoveries for quasicrystals and published, in 1987, a paper on the formation of a stable icosahedral quasicrystal in the Al–Cu–Fe system (Tsai *et al.*, 1987). Quasicrystals have long-range-ordered structure but lack periodicity and belong to the broader class of aperiodic crystals. They were discovered a few years before in rapidly quenched Al–Mn alloys and described in the seminal publication of Dan Shechtman, Ian Blech, John Cahn and Denis Gratias in 1984 (Shechtman *et al.*, 1984). The discovery of a stable quasicrystal by An-Pang Tsai has been crucial in demonstrating the long-range nature of the atomic structure of quasicrystals, a question much debated at that time. It firmly established the notion of quasicrystal as a new class of aperiodic crystals.

Combining his deep knowledge of metallurgy, the concept of Hume–Rothery alloys and experimental intuition, An-Pang Tsai and his group then discovered most of the known stable intermetallic quasicrystals, a long series of new alloys, one of the most recent being the binary Cd–Yb icosahedral quasicrystal in 2000, known as the ‘Tsai-type’ quasicrystal. Those discoveries have been invaluable in understanding the structure and physical properties of quasicrystals and it is fair to say that they have been essential for the attribution of the 2011 Nobel Prize in Chemistry to Dan Shechtman.

An-Pang Tsai held appointments as assistant and then associate professor from 1990 to 1996 at Tohoku University, while from 1993 he was also a visiting scientist at National Research Institute for Metals (NRIM). In 1996 he moved to NIMS, Tsukuba, where he was appointed as a senior researcher. He rapidly became group leader and established the Aperiodic Materials Research group. This is another of An-Pang Tsai’s important contribution to the community. He was indeed fascinated by the structure and physical properties of quasicrystals, which is a very complicated problem. At NIMS he set up a



team of bright young post-docs, now all internationally recognized researchers, and gave them the entire freedom and experimental facilities to tackle the problem. This was one of the great aspects of An-Pang Tsai's personality in training the younger generation: enthusiastic, proposing ambitious targets, but with a long-term perspective, without pressure and with the necessary scientific environment and also friendship. This is quite a rare combination in today's competitive world. Research in his group was carried on many subjects, namely structure determination, physical properties, magnetism, dynamics and also the emerging field of quasicrystal surface science studies, all with major results. Always interested by potential quasicrystal application, he also engaged in pioneering research in Mg light alloys reinforced by quasicrystal particles, leading to several collaborations with the automotive industry.

In 2004 he returned to Sendai as professor at the Tohoku University, in Institute of Multidisciplinary Research for Advanced Materials. He set up a group with both experiment and theory and broad scientific targets on quasicrystal and intermetallic compounds. Important results were regularly published by his group, on the synthesis and phase diagram of new compounds, on the theory of decorated tiling for their structural description, on structure using the high-dimensional approach, on defects and their analysis, on lattice dynamics, on applications for structural materials. He also initiated a very important new field in catalysis, demonstrating first the catalytic properties of quasicrystals but then moving to the study of intermetallic compounds, using new concepts derived from quasicrystals studies. This illustrates the fertility of the scientific career of An-Pang Tsai, its visionary perspective, constantly exploring new directions and opening new doors.

An-Pang Tsai has also been a tremendous coordinator of many research programs in the field of quasicrystals and material sciences. With the help of a research grant from JST (Japan Science and Technology Agency), he started to organize annual meetings on quasicrystals in Japan in 1996, which continued for more than 20 years. These meetings gathered crystallographers, physicists, chemists and sometimes mathematicians and architects, researchers and students interested

in quasiperiodic structures. We will never forget the vibrant inter-disciplinary experience of those meetings. He also organized several international conferences, 'Quasicrystal 2001' in Sendai, AIWQ3 in 2004 in Taipei (Taiwan), 'Aperiodic 2006' in Zao (Japan) with A. Yamamoto and co-organized the ICQ13 conference held in Nepal in 2016. An-Pang Tsai also contributed to the Japan Institute of Metals and Materials as a vice-chairman.

From very early on in his career, An-Pang Tsai built up an impressively large number of collaborations all across the world, in Japan, Europe, USA, Canada, China and Taiwan. His generosity in sharing his discoveries, his constant curiosity and inspiring ideas have irrigated the quasicrystal community, promoting collaboration rather than competition, leading to major results in almost all aspects of quasicrystal research. He was always available and ready to share his knowledge with senior scientists as well as with young students.

In recognition of his achievements, he received many awards including the Medal of Honor with Purple Ribbon bestowed by the Japanese government. He was nominated Academician of the Academia Sinica, Taiwan, in 2018.

An-Pang Tsai was always smiling and had a quiet and gentle approach with everyone he met. Although he always was very active, working constantly, he enjoyed sitting in a bar or at home and sharing a beer with friends and colleagues, having lively discussions on many topics, science of course, but also family, travelling, politics . . .

We have lost a great colleague and a good friend, and we will honor his memory by continuing his interdisciplinary research work, keeping his enthusiastic and collaborative approach. His many friends and colleagues will sorely miss him. Our thoughts go to his wife, children, grandchildren and family.

### References

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