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The Chinese University of Hong Kong
Department of Chemistry
Research Seminar Series

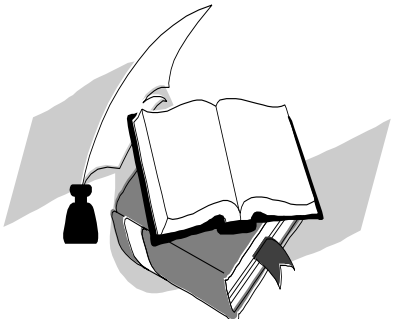
Speaker: Professor Hwan-Ching Tai
Department of Chemistry
National Taiwan University

Title: The Analytical Chemistry of Stradivarius violins: solving a 300-year-old mystery

Date: December 7, 2018 (Friday)

Time: 4:30 p.m.

Venue: L4
Science Centre



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The analytical chemistry of Stradivarius violins: solving a 300-year-old mystery

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Antonio Stradivari (1644-1737) is the most famous violin maker in history. His violins produce sweet and brilliant tones that remain unsurpassed. The "lost secrets" of Stradivari is one of the greatest unsolved mysteries in European culture. Recent research on Stradivari violins have been published in major scientific journals including Nature, PNAS, and Angew. Chem.—the study of antique instruments is becoming increasingly scientific.

By acquiring wood chips removed from Stradivari violins during restoration, we made breakthrough findings about their wood properties, based on solid-state NMR, IR, ICP-MS and DSC/TGA. Our initial findings have been published in PNAS [1] and reported by *The New York Times* and *The Washington Post*. It turned out that Stradivari treated his wood with soluble chemicals including alum and salt. Subsequent aging promoted the degradation of hemicellulose and long-term playing caused the rearrangement of wood fiber molecules.

By synchrotron XRD and SAXS, we have observed that the wood fiber molecules have undergone considerable rearrangements in Stradivarius violins. The ^{27}Al NMR spectra of Stradivari's wood exhibits an unusual combination of 4, 5, and 6-coordinate sites. Further characterization by synchrotron X-ray fluorescence imaging and XANES suggests that there were amorphous alumina nanoclusters dispersed into wood tissues. In essence, Stradivari and his famous rival, Guarneri del Gesu, have created organic-inorganic nanocomposite materials, but many of their properties remain uncharacterized. How 18th-century violin makers managed to create such complex materials still represents a great mystery.

The most valuable musical instrument in the world is no longer the Stradivarius violin but the Chinese zither (guqin) from Song Dynasty. Ancient Chinese believed that aging can improve the sound of guqins after 500 years, and they devised various methods for the artificial aging of wood. Such beliefs are consistent with our observation that hemicellulose has a half-life of ~400 years in violin maples. We have gathered wood samples from antique Chinese guqins ranging from 300-1300 years old to examine their properties, and found some surprising similarities between the famous violins and guqins. How material properties eventually affect acoustic qualities still awaits further investigation. We have recently found that Stradivarius violins exhibit a tendency to mimic female singing voices but the underlying reasons remain unknown [2].

References:

[1] Tai, H. C.*; Li, G. C.; Huang, S. J.; Jhu, C. R.; Chung, J. H.; Wang, B. Y.; Hsu, C. S.; Brandmair, B.; Chung, D. T.; Chen, H. M.; Chan, J. C. C. Chemical distinctions between Stradivari's maple and modern tonewood. Proc. Natl. Acad. Sci. USA, 2017, 114, 27-32.

[2] Tai, H. C.*; Shen, Y. P.; Lin, J. H.; Chung D. T. Acoustic evolution of old Italian violins from Amati to Stradivari. Proc. Natl. Acad. Sci. USA, 2018, 115, 5926-5931.