ICMC Awards

ICMC LIFETIME ACHIEVEMENT AWARD 2017

Professor Kozo Osamura

ICMC has presented its Award for Lifetime Achievement biannually at the CEC/ICMC conference since its 30th anniversary conference in Keystone in 2005 to an individual to “recognize a lifetime’s achievement in advancing the knowledge of cryogenic materials”.

The seventh recipient of the ICMC Lifetime Achievement Award is Kozo Osamura, who follows Edward Collings in 2005, David Larbalestier in 2007, Kyoji Tachikawa in 2009, René Flükiger in 2011, Harold Weber in 2013, and Herbert Freyhardt in 2015.

Kozo Osamura completed his Doctor of Engineering in Physical Metallurgy at Kyoto University in 1970. He was appointed as a Research Associate at Kyoto University in 1970, and was promoted to Associate Professor in 1976 and Professor in 1985. While he held the rank of Research Associate, he was a guest scholar for a year at the Max Planck Institute for Metallurgy in Stuttgart, Germany. He served as director of Mesoscopic Materials Research Center at Kyoto University from 1992 to 1994. In 2005 Osamura became a Professor Emeritus at Kyoto University, and subsequently moved to the Research Institute for Applied Sciences as a chief researcher. In 2015 he became a director of the Institute.

Osamura has been a successful and prolific researcher and professor. He published more than 400 scientific papers, covering a wide variety of subjects in superconductivity, all of which are based on his strong expertise in metallurgy, X-ray and neutron scattering and diffraction, and the mechanical properties of materials. He combined his unique expertise in materials synthesis, synchrotron X-ray and neutron low-angle scattering and diffraction techniques to study both low- and high-temperature superconductors with an emphasis on properties related to practical applications. In the early days of optimizing low-temperature superconductors, he led efforts in Japan that studied the role of α-Ti precipitates as pinning centers in Nb-Ti, and on the impact of mechanical deformation and pinning centers on Nb₃Sn. He developed an excellent relationship with Japanese industry and his scientific understanding of these materials directly contributed to optimizing production of long lengths of Nb-Ti and Nb₃Sn conductors. With the discovery of HTS, he applied his expertise in phase transformations to study reaction pathways in the synthesis of pure HTS materials such as YBCO and Bi-2223. He constructed a phase diagram for the Y-Ba-Cu-O system and discovered a new route to synthesize Bi-2223. Most notably, his phase transformation studies on Bi-2223 contributed significantly to the
present reaction route to form Bi-2223 using a precursor consisting of Bi-2212, alkaline earth cuprates, and plumbate phases.

Osamura has been a leader in the study of the mechanical properties of superconductors, which is essential because of the brittle nature of all superconductors, except Nb-Ti, which must be accounted for in the design of successful high-field magnets. He has made important contributions to our understanding of the mechanical properties of Nb₃Sn conductors. He was also one of the first to study the mechanical properties of Bi-2223 multifilamentary tapes and YBCO coated conductors. Unlike round wire cross sections, these HTS wires have very anisotropic flat tape forms, making cabling and winding without $J_c$ degradation more challenging than for round wires, and requiring a detailed understanding of how the fracture propagates and degrades $J_c$. For example, Bi-2223 tape conductors consist of flake-like Bi-2223 oxide in a ductile and soft Ag matrix. He and his team clarified where the cracks initiate in Bi-2223 and then propagate to failure under various stresses. Recently he has been studying the lamination strengthening of Bi-2223 tapes, important for high field magnet applications, and found that the stress to 95% $I_c$ retention can exceeded 510 MPa by using pretensioned lamination. For YBCO coated conductors he clarified that, since the thin monolayer of YBCO is deposited on the flat, oxide-buffered and strong metal substrates, the mechanical behaviors under tensile and/or bending stress are significantly different from any other of the superconductors. These and his other HTS studies have laid the foundation for the industrialization and application of superconducting wires and tapes.

Osamura has also played an important role in the international superconductivity community, helping to establish the International Electrotechnical Commission (IEC) TC 90 (Superconductivity) working group that prepares the international standards for superconducting materials and devices. He was active in the critical current measurement, tensile test, and general requirement working groups. He was also one of the original organizers of the biennial International Workshop on Mechanical Electromagnetic Properties of Composite Superconductors (MEMS), which is the most important workshop for discussion of the mechanical properties of superconductors that are important for practical applications.

The citation on the award plaque.

In recognition of his unique combination of materials synthesis with synchrotron X-ray and neutron diffraction techniques to understand and advance superconductors, and for his many contributions to developing international standards for superconducting materials and devices.
The ICMC Cryogenic Materials Award for Excellence, is awarded annually at the ICMC Conference, subject to the nomination of an appropriate candidate, to an individual, who is under 40 years of age by the application deadline, to “recognize excellence in advancing the knowledge of cryogenic materials over recent years”. The 2017 award was given to Tengming Shen. Previous awardees were Fumitake Kametani in 2014 and Kazumasa Iida in 2015.

Tengming Shen received his BS and MS in Electrical Engineering at Southwestern Jiaotong University, studying superconducting maglev and materials physics of the newly discovered MgB$_2$ bulk materials. In 2006, he moved to the US to do his PhD studies at Florida State University in 2010, also in Electrical Engineering, with an emphasis on applied superconductivity. His PhD studies played an important role in understanding the underlying materials science to increase the critical current density of Bi-2212. Working with colleagues at the National High Magnetic Field Laboratory and using quench and advanced microscopy techniques, he investigated how the microstructure develops in Bi-2212 round wire through the complex heat treatment. He was instrumental in discovering that the porosity in as-drawn Bi-2212 powder agglomerated into bubbles during the heat treatment, which were the biggest current limiting mechanism in wires. This was a key step leading to developing the overpressure processing heat treatment that squeezes out these bubbles, making Bi-2212 a viable high-field magnet material.

After his PhD studies, Shen received a Peoples Fellowship and moved to Fermi National Accelerator Laboratory, where he studied magnet technology and accelerators. In 2012, he won an Early Career award from the Department of Energy for “Engineering High-field Superconducting Materials for Frontier Accelerator Technology”. He led a team to build and test prototype magnets using new high-field magnet materials, in particular Bi-2212, and to reveal many new aspects of high-field wire and magnet engineering. He investigated the failure mechanisms of superconducting wire when a superconducting magnet quenches and the dependence of the maximum allowable temperature during a quench on winding, stress, and strain conditions of superconducting magnets. He is currently at Lawrence Berkeley Laboratory where he works on magnet technologies for accelerators, nuclear physics and fusion energy, and medical applications.
ICMC BEST PAPER AWARD

The award for the best papers of the 2015 Conference, published in the *IOP Conference Series: Materials Science and Engineering, Vol. 102*, was presented at the 2017 Madison Conference. From the large number of papers nominated by the reviewers, the committee selected one paper for the award.

**Best Superconducting Materials Paper**

J Kvitkovic, R Hatwar, S V Pamidi, S Fleshler, and C Thieme

*for their paper*

“*Temperature dependence of critical current and transport current losses of 4 mm YBCO coated conductors manufactured using nonmagnetic substrate*”

IOP Conference Series: Materials Science and Engineering, Vol. 102, 2015; 012033