FOREWORD

Special Section on Leading-Edge Applications and Fundamentals of Superconducting Sensors and Detectors

Superconducting sensors and detectors enable unconventional measurement that cannot be realized by devices operating at room temperature. The words, "sensor" and "detector," are synonymous, but their usages are different. Accordingly, "sensor" and "detector" appear in the documents for below-mentioned international standards. Sensors using superconducting quantum interference devices (SQUIDs) have a history of 50 years development, and realize the measurement of extremely small magnetic field. Some of the SQUID applications are magnetocardiography (MCG) and magnetoencephalography (MEG), food contaminant inspection, and mineral exploration. In addition, nonlinear *I-V* characteristics of superconducting tunnel junctions (STJs) are indispensable for mixers in heterodine reception. These sensors are categorized as coherent detection for fields.

Another category called direct detection emerged about 30 years ago in order to detect solar neutrinos and dark matters. The direct detectors enable detection of single photons, ions, electrons, which break Cooper-pairs directly. The Cooper-pair-breaking direct detectors include STJ, Microwave Kinetic Inductance (MKI), and Superconducting Strip (SS). Furthermore, other direct detectors such as Transition Edge Sensor (TES), Metallic Magnetic Calorimeter (MMC) rely on temperature rise or resultant change of magnetic susceptibility. The direct detection attracts attention in X-ray astronomy, cosmic microwave background, synchrotron radiation, analytical instruments such as mass spectrometry, electron microscopy, *etc*.

A variety types of superconducting sensors and detectors are emerging, which induced a movement of IEC standards for nomenclature, terms, and testing methods under IEC/TC90 in collaboration with IEEE [1]. It is therefore the best time to collect excellent papers of six invited papers, three regular papers, and two brief papers selected by the editors and reviewers. We hope that this special section introduces this emerging field of innovative superconducting sensors and detectors. Finally, I express my sincere thanks to all authors and the editorial committee listed below for their intense efforts.

[1] M. Ohkubo, "Introduction to IEC standardization for superconducting sensors and detectors," Progress in Superconductivity. vol.14, no.2, pp.106, 2012.

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Masataka Ohkubo *(Member)* Masataka Ohkubo (member) received his M.S. degree in 1983 and Ph.D. in 1991 in electrical and electronic engineering from Toyohashi University of Technology. He worked with Toyota Central R&D Labs., Inc. from 1983 to 1993, and joined the Electrotechnical Laboratory (ETL) in 1993. From 1994 to 1996, he was a guest researcher at Karlsruhe Research Center, Germany. His research interests include the epitaxial growth of high-temperature superconductors, ion beam analysis, and analytical sciences with superconductivity. He was appointed a director of the Research Institute of Instrumentation Frontier (RIIF), National Institute of Advanced Industrial Science and Technology (AIST) in 2011. His current position is supervisory innovation coordinator in Tsukuba Innovation Arena (TIA). His other interests are superconducting strip detectors (SSDs), single-flux quantum (SFQ) read-out circuits, and applications to mass spectrometry and synchrotron-radiation-based materials analysis.

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