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Foreward

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Although Professor Hiroyasu Saka is the Guest Editor of this collection of papers, the authors would also like to dedicate these papers to Professor Saka to recognize his achievements in the field and in honor of his retirement as Professor in the Department of Quantum Engineering, Nagoya University, Japan.

Professor Hiroyasu Saka

Professor Saka has published over 300 papers in leading journals and conference proceedings and made major contributions to many different areas of electron microscopy and materials science. His work has been an inspiration to materials scientists, not only in Japan but throughout the world. His first paper was published in 1966: "An electron microscope study of 17-7PH stainless steel" [1].

Professor Saka was one of the first people to realise that measurements made in a high-voltage electron microscope could be much more representative of bulk material than measurements made in conventional 100 kV electron microscopes. In 100 kV microscopes the specimens are so thin that the surfaces usually dominate *in situ* measurements of, say, dislocation velocities. However, in a high-voltage electron microscope, measurements can be made which often closely approximate bulk values because of the thicker specimens used. In a landmark paper, Professor Saka made direct measurements of the mobilities of edge and screw dislocations in Fe-3% Si *in situ* in an HVEM [2].

Professor Saka has designed and built a range of world-class specimen stages for use *in situ* in a high-voltage electron microscope. For example, an *in situ* tensile testing stage in which stress-strain curves could be recorded, and simultaneously electron microscope images could be taken of the material as it was being deformed [3, 4]. Professor Saka used these stages to make direct observations of the multiplication of dislocations in iron single crystals [5] and other materials.

Professor Saka then added temperature capability to his tensile testing stage and constructed a new tensile testing device useable over the range -150°C to room temperature [6, 7]. He applied this stage to study the low-temperature deformation of a variety of materials including Fe-3% Si [8] and Fe [9]. It is remarkable to realise that this variable-temperature tensile testing stage was constructed over thirty years ago and it remains world-class today.

Professor Saka then designed a fatigue stage for *in situ* HVEM experiments [10] and a specimen holder for *in situ* observations in a controlled atmosphere [11], and he made many innovative studies using these special stages, before extending the temperature range of his straining stage down to liquid helium [12].

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Professor Saka performed fundamental ground-breaking work on the detailed mechanism of the climb of dissociated dislocations, in collaboration with Barry Carter, David Cherns and Peter Hirsch [13, 14], and on the temperature dependence of stacking-fault energies [15].

In a world-leading paper, Professor Saka studied a liquid in an electron microscope, which many people at the time believed to be impossible. In particular he studied *in situ* at near-atomic resolution a solid/liquid interface in a high-resolution electron microscope [16]. This work, performed in 1985, was the start of a major new research theme for Professor Saka: the mechanisms of solid/liquid and solid/solid phase transformations which he studied *in situ* in a TEM.

Professor Saka has not only performed world-class work in electron microscopy, but also in X-ray topography, and, for example, he has made dynamical *in situ* studies of microstructural changes in a variety of crystals using X-ray topography [17].

It is impossible to feature all the outstanding research of Professor Saka in this short introduction, so I shall move rapidly to his recent work. Professor Saka's work now encompasses semiconductors as well as metals and ceramics. He has pioneered the use of novel specimen preparation techniques, such as focused ion beam. He has continued to use the most advanced electron microscopy techniques, such as electron holography. Bringing all these topics together, in 2002 he published a fascinating paper on the electron holographic characterisation of electrostatic potential distributions in a transistor sample fabricated by a focused ion beam [18].

Professor Saka is extremely well-known internationally. His world-class work on *in situ* and conventional electron microscopy of defects in metals, ceramics and semiconductors, his pioneering work on solid/liquid and solid/solid phase transformations and his outstanding work on the dislocation toughening of brittle materials have inspired electron microscopists and materials scientists throughout the world to follow where he has led. The papers in this volume were presented by his friends and colleagues from around the world at an International Conference in Nagoya University, held on 26–27 January 2005, to mark his official retirement. However, as the last paper by Professor Saka shows, he continues to be on a peak in his research career, and it is impossible to think of him being retired! We wish him and his wife many more happy and healthy years.

Colin Humphreys

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