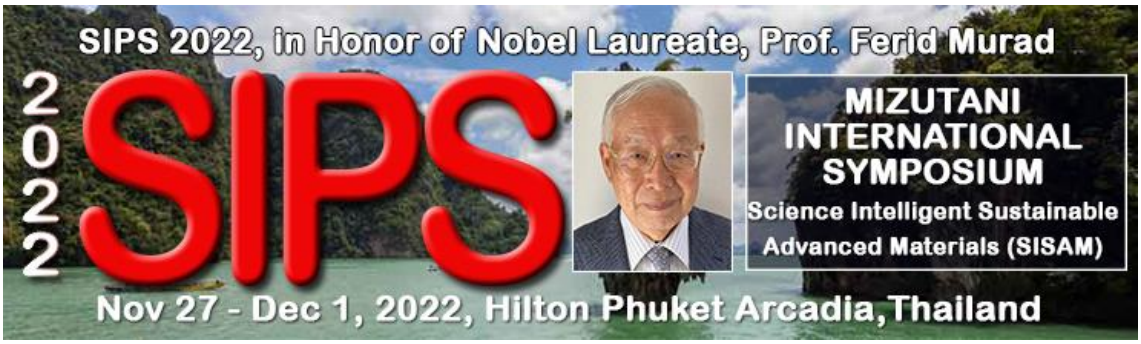

Scientific biography of Uichiro Mizutani

Emeritus Professor of Nagoya University, Nagoya, Japan, and Fellow at Nagoya Industrial Science Research Institute, Nagoya, Japan

Uichiro Mizutani was born in 1942 in the city of Nagoya, Japan. He concluded his PhD thesis at Nagoya University in 1971, entitled "Experimental Studies of the Electronic Structure of Hume-Rothery Alloys Based on the Noble Metals". This has led him directly into the research pioneered by Hume-Rothery and his associates several decades earlier. His subsequent extended visits to the USA over 1970-75, where he worked with Professor T. B. Massalski, at the Mellon Institute in Pittsburgh, further deepened his interest in the Hume-Rothery field. As the most notable feature in this period of time, he established the existence of a universal relationship between the electronic specific heat coefficient and electron concentration, i.e., the number of itinerant electrons per atom, often abbreviated as **e/a**, in each phase of different Hume-Rothery alloy systems. He could unambiguously explain the **e/a** dependence of the measured electronic specific heat coefficient by constructing possible Fermi surfaces for each phase. His terminology for the Hume-Rothery phases has been now widely accepted.

In his later work on metals and semi-conductors over a wide range of materials like amorphous alloys, quasicrystals and their approximants, Mizutani stressed the existence and importance of a pseudogap across the Fermi level and demonstrated how this can contribute to the stability of numerous phases and also affects substantially their electron transport properties, thereby showing that they constitute yet another group of phases that may be properly regarded as Hume-Rothery phases equipped with a pseudogap across the Fermi level. Hume-Rothery would have been delighted to know that the Fermi surface-Brillouin zone interactions explain so successfully the electronic behavior not only of numerous crystalline phases but also of many amorphous and quasi crystals in metallic, semi-metallic and insulating states.

Over a span of almost a centennial year, Hume-Rothery rules have been the subject of detailed examination and elucidation. Mizutani has been involved during the past fifty years in research on this topic, starting from the work on the noble metal alloys in

the 1970s, and amorphous alloys in the 1980s. A growing interest in the Hume-Rothery rules has revived and became intensified soon after the discovery of the quasicrystal in 1984. Such structures are characterized by the symmetry of an icosahedron, but lacking the translational symmetry, and they can be regarded as structurally complex aperiodic, but ordered, electron compounds.

During the past three decades, much research interest has occurred in this new field. In connection with the needed understanding of the more basic physics behind the stabilizing effects related to the electron concentration, Mizutani and his long-time partner, Dr. H. Sato, embarked on theoretical studies to gain a deeper insight into the origins of the Hume-Rothery electron concentration rule by making full use of first-principles Full-potential Linearized Augmented Plane Wave (FLAPW) band calculations. They have successfully established the so-called FLAPW-Fourier theory and led to successful interpretation of the Hume-Rothery electron concentration rule with a particular emphasis on its applicability over a wide range of materials whose bonding is metallic, ionic or covalent, or a changing mixture of these.

Mizutani has benefited very substantially from the support, advice and help of three key scientists. In the first place, he wishes to express his special thanks to Emeritus Professor of Aichi University of Education, Dr. Hirokazu Sato mentioned above, who has made substantial contribution from the theoretical side in constructing the FLAPW-Fourier theory. Mizutani has also received substantial influence from Emeritus Professor of Yokohama City University, Dr. Keiichi Ogawa. Special thanks are also due to Emeritus Professor Thaddeus B. Massalski, Pittsburgh, USA, who actually guided him into this fascinating research field, which he found so challenging, at the time in early 1970s when he worked as a postdoctoral fellow at Carnegie-Mellon University.

The consistently robust studies throughout his academic life have been supported through extensive discussions with many colleagues in Japan: Professor T. Takeuchi, Toyota Technological Institute, Professors Y. Nishino and H. Miyazaki, Nagoya Institute of Technology, and Professor T.Homma, Nagaoka Institute of Technology, to whom Mizutani wishes to express his deep thanks on this occasion.

Special and personal thanks are dedicated to the late Dr. Esther Belin-Ferré, LCPMR-UMR, Paris, France, and Emeritus Director Jean-Marie Dubois, Institut Jean Lamour, Ecole des Mines de Nancy, France, for repeated exchanges of opinions on **e/a**-issues evidenced from Esther's soft-x-ray absorption spectra for many quasicrystals

and approximants. Particularly, Mizutani wishes to express his sincere thanks to Jean-Marie for his continuous efforts to make him to be recognized with the prestigious award in the SIPS 2022 symposium.