Z. Nishiyama

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1901-1991

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ZENJI NISHIYAMA, the world's foremost researcher in martensitic transformations, died on March 12, 1991. He was eighty-nine. His research studies on the martensite transformation, which served as the basis for heat treatment of steels, revolutionized understanding of this important crystallographic structure in steels. The spectacular success of the Japanese steel industries in developing dual-phase, high-strength low-alloy (HSIA) steels is greatly due to Professor Nishiyama. His research and that of his students directly contributed to the development of the steels, and his former students are in practically every major academic department, research institution, and research laboratory of steel companies. His legacy is the immeasurable contribution of his leadership in organizing and mobilizing physical metallurgists in Japan in research on thermomechanical treatments of steels and other alloys in Japan as well as in other countries.

Professor Nishiyama was born in Nagasaki, Japan, in 1901 and received his B.S. and D.Sc. degrees, both in physics, from Tohoku University (Tohoku Imperial University then) in 1927 and 1934, respectively. From 1927 to 1936 he was a research assistant in the Research Institute for Iron, Steel, and Other Metals at Tohoku University, and it was then that he served as a research associate with Kotaro Honda. From 1936 to 1939 he was an assistant professor at Tohoku University, and then from 1939 to 1941 an assistant professor at the Institute of Scientific and

Industrial Research at Osaka University. In 1941 he was promoted to full professor there, where he stayed until 1965. He then took a position as special staff member, Fundamental Research Labs, with Nippon Steel Corporation, where he stayed until 1978.

Early in his career, shortly after he began working on analysis of crystal structure of martensites, he discovered the carbon concentration dependence of the c/a ratio in tetragonal martensite. The report (*Kinzoku-no-Kenkyu* 10 [1932]: 1) coauthored with Professor Honda is still cited regularly in the literature published in this field. The most well-known discovery by Professor Nishiyama is the Nishiyama relations that established the crystallographic relation between matrix crystals and martensite crystals (*Science Reports Tohoku University* 23 [1934]: 637). For this discovery and various other contributions, he is called Mr. Martensite along with Georgy V. Kurdjumov, the discoverer of another martensite crystallographic relation, the Kurdjumov-Sachs relation.

His research of martensite was started with steels and developed further with various nonferrous alloys. Professor Nishiyama led the research on martensite in this new area, determining crystal structure and substructure of various martensite phases. His comprehensive text, *Martensitic Transformations,* was translated into English and is still a much-used source book. Many important and interesting phenomena such as the shape memory effect (SME) were found in direct connection with the thermoelastic martensite transformation. The SME alloys were in the limelight because of their functional abilities: they were used as fasteners, couplings, thermoelastic devices, and heat engines, among other applications.

The impacts of Professor Nishiyama's accomplishments over the span of his career were felt particularly in three very important and dramatic technological advances in metallurgy following World War II. These were thermomechanical treatment of steel (ausforming, TRIP steels, controlled-rolled HSLA steels, etc.), dual-phase steels (a key factor in the present technological superiority of Japanese automobiles), and shape-memory alloys.

For his unprecedented contributions to the field of metal

lurgy, Professor Nishiyama was recognized with numerous awards and honors. These included the Meritorious Honor, Best Paper Awards, and Society Medal of the Japan Institute of Metals; the Hattori Prize from the Iron and Steel Institute of Japan, 1936; the Seto Award from the Japan Society of Electron Microscopy, 1962; the Toyo Rayon Science and Technology Award, Toray Science Foundation, 1965; the Gold Medal of the Japan Institute of Metals; the Honda Medal of the Honda Memorial Foundation, 1972; the Japan Academy Prize (Nippon Gakushiin Sho) from the Japan Academy, 1973; and the Science and Technology Prize from the Toray Science Foundation. He is a recipient of the Third Order of Merit with the Cordon of the Rising Sun from the Japanese government. Commemorating his eminent past performance, the first International Symposium on "New Aspects of Martensitic Transformation" was held under the auspices of the Japan Institute of Metals in 1976.

He was elected a foreign associate of the National Academy of Engineering in 1982, and he was also a member of the Japan Academy of Engineers. Nishiyama was an honorary member of the Japan Institute of Metals and served as its vice-president in 1962 and also on its Governing Board and Board of Trustees. He was a life member of the Physical Society of Japan and a member of the Governing Board and the Board of Trustees of the Crystallographical Society of Japan. He also served on the Governing Board of the Honda Memorial Foundation. He was the author or coauthor of more than two hundred publications.

He retired from professorship at Osaka University in 1965 and worked for Nippon Steel as a special staff member until 1978. He enthusiastically attended scientific conferences in his field and was vigorously involved in discussion even up to a few months before his death.

Nishiyama was unquestionably the leading and most respected metallurgist in Japan. Not only was he well known around the world, but his research contributions on martensitic transformation became a part of the educational core of physical metallurgy. Starting from his very early work of orientation relationships, he contributed continually to the detailed examination of this area. The development of the electron microscope made it

possible for him to extend these studies not only in steels but also in other materials. He was, in the true sense of the word, a scholar who could not rest until he felt completely comfortable with his understanding of the problem.

It should also be recognized that Nishiyama's students and their students were, in considerable measure, responsible for much of the modern intellectual approach to Japanese metallurgy, particularly in the iron and steel industry. It was a remarkable tradition that he fostered. While this great metallurgist has gone from the scene, he lives on in his publications and in the generation of students he trained.