# PREFACE

This volume contains the papers presented at the International Symposium on Mechanical Alloying (ISMA) held in Kyoto, Japan during May 7-10, 1991. ISMA was organized by the Japan Society of Powder and Powder Metallurgy.

Research activities on the formation and properties of metastable and non-equilibrium alloy phases using mechanical alloying (MA) have recently been gathering world wide attention in the field of materials science. MA has been attracting enthusiastic attention among researchers. MA, or, in a broader sense, the use of mechanical energy in producing non-equilibrium phases, so far has been the least studied among several "energize and quenching" processes listed by D. Turnbull (1978) for the production of the metastable state of materials.

Researchers, who have been working for many years on different energize and quenching processes, such as vapor deposition, irradiation, rapid quenching, etc., have recently started engaging in mechanical alloying. The large potential in producing amorphous alloys has drawn many scientists away from rapid quenching and into MA.

Nano-crystalline materials, which were speculated to possess physical and chemical properties substantially different from conventionally grain-sized materials, have been proved to be easily produced by MA. Further, intermetallic compounds, which can be made by the SHS process, can be produced by MA, by starting from the mixtures of elemental powders, then decreasing the free energy gradually in a controlled setting, which contrasts to the very rapid reaction in the case of SHS.

The study of chemical reactions, organic and inorganic, under the influence of mechanical energy is a branch of chemistry which has a long history known as mechano-chemistry. Researchers of MA could greatly benefit from the mechano-chemistry, and the reverse is also true. The reaction ball-milling for the synthesis of metal nitrides and hydrides is a typical case of such correlation between these two fields.

MA is a key process technology in producing the oxide dispersion strengthened superalloys. However, there is still a lot to be explained in the dispersion strengthening process. Also, there are many things to be learned by the researchers in the non-equilibrium alloy phases from conventional mechanical alloying processes.

ISMA was conceived at the time of the 1989 TMS fall meeting when Dr. J. deBarbadillo of INCO and myself discussed the new trends in MA. When the schedule of ISMA was announced in April 1990, after a quick decision by Professor T. Takada, then the president of Japan Society of Powder and Powder Metallurgy, the response from researchers all over the world was overwhelming. The number of participants in ISMA, despite limited preparation time, far exceeded our expectations.

The manuscripts gathered here have a variety of topics and different points of interest. Yet I found every one of them contain rather intriguing new findings which aid in understanding the nature of MA. All of the manuscripts were reviewed by the editorial committee. Most of these were printed in this volume as they were received. This was done in order to maintain the integrity of the findings in this young research field. I certainly believe that this volume is a worthwhile and timely summary of the status of this fascinating and "new" field of research.

I am honored to thank the members of the international advisers, the organizing and steering committees, and all of the participants for their sincere cooperation to make ISMA successful in every aspect. Last, but not least, thanks are due to the Miyashita Foundation, Iketani Foundation, Kajima Foundation and Nippon Sheet Glass Foundation, as well as over 50 American and Japanese companies, for their generous financial contributions in support of ISMA.

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