
Preface

Alloying may be defined as “the process of adding one or more elements or compounds to interact with a base metal in order to obtain beneficial changes in its mechanical, physical, or chemical properties or manufacturing/processing characteristics.” For the purposes of this publication, the definition has been limited to those alloying processes that affect the *bulk* of the material; therefore, surface alloying processes such as carburizing, nitriding, ion implantation, and hot dip galvanizing are not covered. However, elements or compounds that lead to a preferential microstructure and subsequent improved properties are covered. Examples of these are grain refiners (grain refining results in better forming or higher strength), inoculants added to molten cast irons to produce changes in graphite distribution and improvements in mechanical properties, magnesium-containing nodulizing (or spheroidizing) additions in ductile irons for high strength and ductility (up to 18% elongation), and the addition of certain elements, such as calcium, sodium, strontium, and antimony, to refine the structure of aluminum-silicon casting alloys as well as improve their tensile properties and ductility. Also included are discussions of some powder metallurgy (P/M) materials that technically may fall outside the definition of alloying given above. An example is copper-base dispersion strengthened materials. Copper can be strengthened by using fine dispersed particles of aluminum oxide. Because this oxide is not immiscible in liquid copper (i.e., it does not “interact”), dispersion-strengthened copper cannot be made by conventional ingot metallurgy and alloying techniques; P/M techniques must be used. Dispersion-strengthened superalloys made by “mechanical alloying” are also described.

Although emphasis has been placed on deliberate alloying additions (minor or major alloying elements), the effects of trace or tramp elements are also summarized. Such impurities can have a profound affect on processing and properties of metals and their alloys. For example, impurity levels in the parts per million range can significantly lower the electrical conductivity of copper.

I wish to thank a number of people who provided invaluable assistance throughout this project. The introductory article, "Principles of Alloying," was authored by Hugh Baker, consulting editor to ASM and a longtime contributor to the ASM Handbook and Phase Diagram programs. I have had the privilege of working with Hugh for some twenty years. Thanks are also extended to Larry Korb (Rockwell International), an ASM Fellow and past Chairman of the ASM Handbook Committee. Larry was instrumental in defining the scope of the book and supplied material for several articles, including those on carbon and low-alloy steels and aluminum alloys. Finally, the helpful comments and assistance from the ASM Editorial staff are acknowledged. In particular, I would like to thank Steve Lampman from Technical Publications for his involvement in the early stages of the project.

Joseph R. Davis
Davis & Associates
Chagrin Falls, Ohio