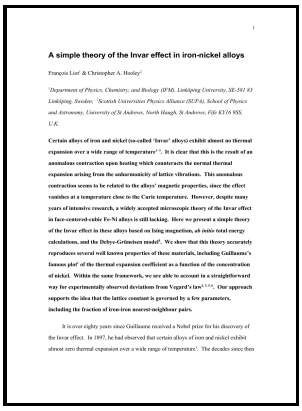
Physics and applications of Invar alloys.

Maruzen Co. - Invar properties



A simple theory of the Invar effect in iron-nickel alloys

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Certain alloys of iron and nickel (so-called 'Invar' alloys) exhibit almost no thermal expansion over a wide range of temperature[1-3]. It is clear that this is the result of an anomalous contraction upon heating which counteracts the normal thermal expansion arising from the anharmonicity of lattice vibrations. This anomalous contraction seems to be related to the alloys' magnetic properties, since the effect vanishes at a temperature close to the Curie temperature. However, despite many years of intensive research, a widely accepted microscopic theory of the Invar effect in face-centered-cubic Fe-Ni alloys is still lacking. Here we present a simple theory of the Invar effect in these alloys based on Ising magnetism, ab initio total energy calculations, and the Debye-Grüneisen model[4]. We show that this theory accurately reproduces several well known properties of these materials, including Guillaume's famous plot[1] of the thermal expansion coefficient as a function of the concentration of nickel. Within the same framework, we are able to account in a straightforward way for experimentally observed deviations from Vegard's law[5-7,9]. Our approach supports the idea that the lattice constant is governed by a few parameters, including the fraction of iron-iron nearest-neighbour pairs.

It is over eighty years since Guillaume received a Nobel prize for his discovery of the Invar effect. In 1897, he had observed that certain alloys of iron and nickel exhibit almost zero thermal expansion over a wide range of temperature[1]. The decades since then

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Physics And Applications Of Invar Alloys

FeNi36 Invaritself is still used today in vast numbers of household appliances, from electric irons and toasters to gas cookers and fire safety cutoffs. Invar Invar, also called FeNi, is a special class of metal known as an and is 64% by weight and 36%. This is reflected in Table 1.

Invar Alloys

The sharp minimum occurs at the Invar ratio of 36% Ni.

Invar Properties & Low Coefficient of Thermal Expansion

Like other nickel iron compositions, is a solid solution; that is, it is a single-phase alloy — similar to a dilution of common table salt mixed into water. Further, SuperInvar has a highly temperature-dependent temporal stability and may be difficult to fabricate Ref. One should note a few differences between Invar 36 and 304 stainless steel however.

Effects of texture on the etching property of Fe

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Invar and Its Applications

Bunge, Texture Analysis in Materials Science, Butterworths Pub. Other applications for these are continuing to be found in industry for advanced electronic components, filters in mobile phone networks and even as tank membranes for massive liquefied natural gas transport ships.

Using Ag95Al

Greater atomic bonding energy in the material will yield a lower CTE; therefore ceramics with relatively strong interatomic bonding have lower CTEs than polymers and metals. The amount of information What is Invar? The low expansion coefficient of fused silica can be explained by a low atomic packing density such that interatomic expansion produces relatively small macroscopic dimensional changes. Besides the variation in CTE

vs.

Invar and Its Applications

The sharp minimum occurs at the ratio of 36% Ni.

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