●Development Stage

(Fiscal Year 2007–2009)

Central Iwate-Kamaishi Area

Research and Development of high-value-added Co-based alloys from Iwate

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Life Sciences
IT
Environment
Nanotech Materials
Others

Framework for Project Promotion

Project Director……Tsuneyoshi Nagayoshi
Deputy Project Director ……Katsuo Takita
Chief Scientist ……Akihiko Chiba
Science and Technology Coordinator…Shirou Abe
Kuratoshi Sasaki

Core Research Organizations

Iwate University, Institute for Materials Research (Tohoku University),
Tokyo Medical and Dental University, Iwate Institute Research Center

Major Participating Research Organizations

Industry…Eiwa Co., Ltd., TOKOSHA CO., Ltd., NEWTON Co.,Ltd.,
Morioka Seiko Instruments Inc., Chida Particularity Industrial Corp.,
Seiko Instruments Inc., Epson Atmix Corp.,
Yoneda Advanced Casting Co., Ltd.
Academia…Iwate University, Institute for Materials Research (Tohoku University),
Tokyo Medical and Dental University
Government…Iwate Institute Research Center,
Kamaishi Otsuchi Industrial Research Development and Training Center

Aims of Project

The central Iwate-Kamaishi area is the site of the development and commercialization of new Ni-free Co-based alloys for biomedical applications. During the Basic Stage (fiscal years 2004 to 2006), research and development into adding value to the developed alloys focused on their use as medical devices such as artificial hip joints. Consequently, various Co-based alloys have been successfully developed with excellent wear resistance, no substantial Ni toxicity, and reduced magnetic susceptibility. In addition, to enhance the biomaterials industry in Iwate Prefecture, we identified specific needs for Co-based alloys and developed a relationship with domestic companies for medical devices based on industry-academia-government cooperation.

In the Advanced Stage, we are aiming at further develop the results attained in the General Stage to enable industrial application of the alloys, as well as conducting cooperative industry-academia-government research to meet the specific needs of industry.

We are also seeking to organize an “Advanced Forum of Co-based alloys in Iwate” to establish lasting industry-academia-government relationships.

Contents of Project

1. R&D to promote the commercialization of biomedical Co-Cr-Mo alloys
   We are engaged in R&D on fabrication technology to make use of Co-based alloys as biomaterials. We also seek to develop Ni-free Co alloys and Co alloys with reduced magnetization, suitable for avoiding metal-induced MRI artifacts.

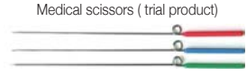
2. Development of Co-Cr-Mo alloys for industrial use
   We intend to apply Co-Cr-Mo alloys in other applications that require biomaterials by considering various properties of the alloys of interest. We aim to make use of the alloys in cooperation with industry partners.

3. R&D on recycling techniques for Co-based alloys
   In this project, we focus on research and development in three main areas: 1. the supply of scrap Co-based alloys, 2. recycling technology, and 3. the cost of recycling, with the aim of developing techniques of recycling Co-based alloys from used products, as it is necessary to ensure a stable supply of Co, Cr, and Mo as raw materials.

Main Results

1. R&D for promoting the commercialization of biomedical Co-Cr-Mo alloys
   In order to establish fabrication technology for the manufacture of artificial hip joints using closed-die forging, we studied the high-temperature deformation behavior of the developed Co-Cr-Mo alloys and compiled processing maps. The optimum conditions of hot-forging were determined based on the obtained processing maps. A knowledge of grain refinement and improvement in the workability of Co-Cr-Mo alloys have been obtained for producing the fine tubing and sheets used in making vascular stents. The properties of the developed alloys were investigated with the aim of expanding the applications of the developed alloys as dental and biomedical materials. The alloys show better corrosion resistance (e.g., resistance to pitting) than SUS316L stainless steel, good resistance to blood clotting, and low cell toxicity. Medical devices such as scissors, tweezers, and veterinary acupuncture needles were produced as a commercial trial.


Medical scissors (trial product)


Needles for veterinary acupuncture


Veterinary acupuncture: Healed animal

2. Development of Co-Cr-Mo alloys for industrial use
   We identified the mechanisms of the increasing strength and elastic modulus of Co-based alloys used as springs in high-quality watches. The processing technology required for a Co-based alloy with a Young’s modulus of 270 GPa has been developed, involving plastic deformation and subsequent heat treatment. The alloys developed for screws and cylinders of injection-molding machines showed high corrosion-wear resistance, 25 times higher than that of conventional alloys. We developed an apparatus to measure the corrosion-wear properties of the developed alloys. To clarify the machinability of the developed alloys as materials for use as a die and mold, we investigated the machinability and wire-spark cutting property of the alloys.

3. R&D for the recycling techniques of Co-based alloys
   We determined the material flow of Co sourced in Japan. The temperature-dependent specific heat capacity was obtained by measuring the high-temperature heat capacity of Co-Cr-Mo alloys.