Session Chairperson
Aisin Keikinzoku Co., Ltd. Shinichi Asai

JD22-01

Effect of various surface treatments on the soldering and erosion behavior in molten aluminum alloy

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Various surface treatments have been applied in order to protect aluminum die-casting molds from damages, such as soldering and erosion in molten aluminum alloy. Among these treatments, the PVD method for producing various ceramic coatings at low temperature is a promising process.
We have developed a new AlCrTiSiN-based nano-composite multilayer coating with excellent wear resistance, heat resistance, and mold release property using a special PVD facility that can form a dense coating with few defects. The properties of SKD61 specimens coated with nano-composite multilayer coatings were compared with those of untreated specimens, gas nitrocarburized specimens, gas nitrocarburized and oxidized specimens, and various coatings prepared via PVD. Properties such as the hardness, microstructure, crystal structure, tribological property, and soldering and erosion resistance in a molten aluminum alloy were compared.

JD22-02

Effects of PVD coating, lubricant and shot peening on die casting dies.

Oerlikon Japan Co., Ltd.
YUSHIRO CHEMICAL INDUSTRY CO., LTD.
● Takashi Osaki, Fukui Shigeo
Shimizu Yuichiro, Goto Hisanori

With a growing need of automotive lightening, there is a great demand for Al die cast parts which is lighter and with high dimensional accuracy, as an alternative to steel parts. In order to improve the price competitiveness of Al die cast parts and increase its productivity, reducing the downtime and maintenance time by improving mold life-span is needed. The factors contributing to shortening mold life include seizure heat check and erosion.
We have been receiving a high valuation of PVD coating the coating technologies which realize longer lives of die components such as core-pin and insert. We verify the effect of the combination of PVD coating, lubricant and shot peening, which enables further life extension.

JD22-03

Erosion Resistance of Cast Steel and Spheroidal Graphite Cast Iron Containing High Manganese in Molten Aluminum Alloys

Graduate School of Engineering Science, Akita University
Akita Industrial Technology Center
Hokkou Metal Industry Co., Ltd.
● Kuzo Goto (Ph. D.)
Kengo Kurosawa (Ph. D.)
Masanori Chiba,
Toshiharu Kon

Erosion of ferrous components such as shot sleeves becomes a problem in aluminum die casting processes. Our research team has been engaged in the clarification of the erosion mechanism. The obtained results indicated that the saturation solubility of iron in the molten aluminum alloys is a dominant factor affecting the dissolution rate of iron through the intermetallic layers that are formed at the contact interface between the melts and the ferrous materials. Meanwhile, another results implied that the ferrous materials including high manganese have good erosion resistance in the melts. In this study, we conducted the erosion testing of the cast steel and spheroidal graphite cast iron containing high manganese and other several ferrous materials. Based on the obtained results, we quantified the erosion resistance, and investigated the mechanism of the resistance.

JD22-04

The evaluation of Ti matrix composite shot sleeve for the development

TYK CORPORATION
● Sadayasu Takayama,
Shinji Kajita, Yukie Kaku

We are producing and selling Ti matrix composite shot sleeves having the excellent heat-retaining property for aluminum alloy die-casting. In fact, the sleeve contributes to quality improvement and yield improvement of diecastings with reduction of cold flakes. In recent years we developed the harder material and the structure to reduce thermal deformation and heat load, thereby the life of the sleeve became more stable and longer.
On this time, we re-evaluate the sleeve through current status of use at production site and insulation characteristics, thermal deformation characteristics in experiment for future further improvement.

Session Chairperson

Advanced Composite Corporation Hideto Sasaki

JD22-05

Die Casting Die Problems and Their Countermeasures

Hihara consultant office ● **Dr. Masahiko Hihara**

The trouble of the die casting die accompanied with the outbreak of a heat checking and the crack associated with the low cycle thermal fatigue and with contacting at the high temperature molten metal (Al, Mg, Zn) and die surface erosion, wash out and cavitation erosion etc. When these troubles occur on the die casting die surface, the causes many problems such as decrease of the quality of the casting product and of the productivity and the increase of the operation expense. This report describes the improvement methods for stable die casting based on the analysis of the current status of die casting die problems, including examples of heat treatment methods for large scale materials, application of effective surface treatment and improvement methods to maintain stable operation.

JD22-06

Development of high thermal conductivity die steel-based powder for 3D printing

Daido Steel Co., Ltd. ● **Takashi Yoshimoto, Asako Kamimoto, Koichiro Inoue (Ph. D.)**

Aluminum die-casting parts, which are effective in reducing weight and the number of parts, are expected to increase in demand for the electrification of vehicles and carbon neutrality. Thus, requests for reduction of product failure rate and mold maintenance, as well as high cycle rate, will also increase. Die with conformal cooling circuit by 3D printing is one of the solutions to these problems and its application is expanding. Conventionally, maraging steel was the only option for 3D printing powder for molds. On the other hand, maraging steel has problems such as heat-checking, cracking at water cooling hole, and legal restrictions, and practical application of die steel-based 3D printing powder is required. In this presentation, we report on the development concept of die steel-based powder with practical performance and the die characteristics verified by comparison with conventional steels.

JD22-07

Achieving High-quality Aluminum Die Casting via Cooling Control with Additively Manufactured 3D Cooling Dies and Preventing Corrosion of Cooling Channels

HIBINO INDUSTRY Co., Ltd. ● **Makoto Kato, Masahiro Sugiyama, Mitsuhiro Karaki**
MEC INTERNATIONAL Co., Ltd. **Tsutomu Shibata**
Aichi Center for Industry and Science Technology. **Dr. Eng. Masaki Kato**
Aichi Science & Technology Foundation **Dr. Eng. Hiroaki Iwahori**

In order to achieve high-quality aluminum die-casting and prevent aluminum soldering to the surfaces of dies, an insert die with three-dimensional cooling channels was fabricated via selective laser melting method and a nanocarbon coating effective in improving molten metal fluidity was developed and applied to the surface of dies. The die was verified capable of being maintained at the optimum temperature via the intermittent water flow control during continuous die casting operations, and consequently high-quality aluminum die casting were achieved. Moreover, Ni-P plating was confirmed effective against the corrosion of the inner surfaces of the cooling channels.