New products and technique in material processing technologies

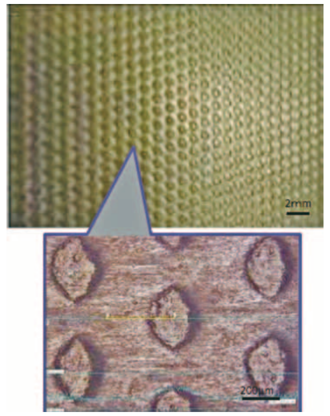

Fig.1 Surface conditions of high-heat-transfer titanium, HEET®

State-of-the-art material processing technologies involving forging, casting and powder metallurgy are designed to save resources with high yield and to save energy, by reducing weight while increasing strength, for example, and thus are excellent in environmental protection. These technologies are widely used in producing various parts for machinery and equipment, e.g., transportation machines including automobiles, aircraft and ships, as well as for power and chemical plants. This issue introduces new products in the field of material processing along with their manufacturing and evaluation technologies with special focus on the casting/forging of steel, processing of titanium and iron powder, and casting/forging of aluminum alloys.

Fig.1 shows the surface condition of high-heat-transfer titanium plate, HEET®, newly developed for plate-type heat exchangers. This unevenness pattern, formed with transfer-printing during the rolling process, is characteristic of HEET. Controlling the unevenness of the pattern has improved the heat transfer performance by 20% or greater, compared with smooth plates.

New Materials and Technologies for Automobiles

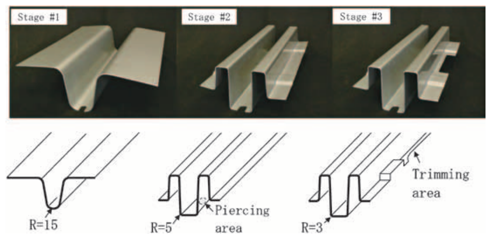

Fig.2 Change in member shape during multi-stage hot stamping

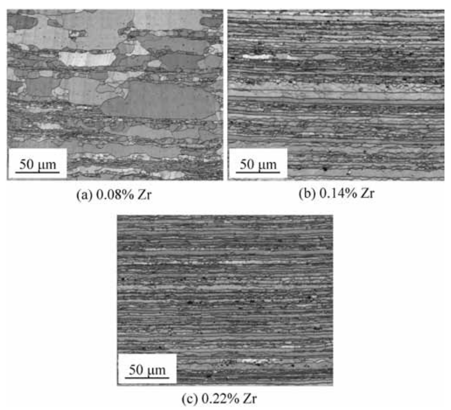

Fig.3 Effect of amount of Zr addition on refinement of grain size in alloy extrusions

In the medium-term management plan, the Kobe Steel Group plans to focus its management resources on the weight reduction of transportation vehicles, an important field in the medium to long term, to further enhance its unique additive values and to demonstrate its competitive advantages. This special edition introduces the group's new products and technologies related to steel, aluminum, copper, etc., that contribute to the safety improvement and body-weight reduction of vehicles. Evaluation technologies and solution technologies are also introduced.

Fig.2 shows forming parts of a steel sheet developed by Kobe Steel for highly productive hot stamping. These metal forms are shown as they are in the process of multi-stage hot stamping. This process consists of three stages: the first stage for rough forming, the second for main forming, including piercing, and the third for final forming, including trimming. Kobe Steel's steel sheets for highly productive hot stamping enable the forming of complex shapes that could not be realized with the conventional hot-stamping steel sheets; furthermore, they make it possible to add piercing and trimming to the hot stamping processes.

Fig.3 includes micrographs showing how the addition of Zr inhibits recrystallization in the alloy extrusions. Coarse recrystallized grains are observed in the alloy with the addition of 0.08 wt% Zr, while the recrystallization has been inhibited in the alloy with the addition of 0.14wt% Zr. The alloy with the maximum Zr addition of 0.22wt% exhibits an even finer microstructure. Zirconium, if finely dispersed, pins the grain boundaries, which inhibits recrystallization during hot extrusion and thus creates a fibrous micro-structure in which the crystal grains are elongated in the direction of extrusion. These fine crystal grains inhibit the occurrence of stress corrosion cracking (SCC) and the propagation of cracks. The chemical composition and production process have been optimized to reduce coarse recrystallized grains, which has enabled successful development of highly SCC-resistant extrusions based on a high-strength 7000 series alloy.

<Cover photos>

The photos on the front cover include: [Feature I (top)] Some products to which Kobe Steel's material processing technologies are applied: i.e., a built-up type crankshaft whose maximum total weight may reach around 400 tons for low-speed diesel engines in vessels (left), a titanium alloy fan case for the V2500 jet engine (upper right), and a motorcycle muffler made of titanium alloy (lower right). [Feature II (bottom)] Automotive parts to which Kobe Steel's lightweight materials are applied: i.e., an engine hood made of aluminum sheet with excellent pedestrian protection performance (upper left, provided with the permission of Nissan Motor Co., Ltd.), a seat frame made of high strength steel (upper center), a suspension member made of forged aluminum (upper right), a bumper reinforcement made of aluminum extrusion (lower left), a door impact beam made of aluminum extrusion (lower center), and a side door module made of aluminum sheet (lower right).

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