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Fabrication of Lotus-type Porous Metals by Continuous Zone Melting and Continuous Casting Techniques

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Lotus-type porous metals with low thermal conductivity are fabricated by continuous zone melting technique, which possess directional elongated pores. The porous metals have been able to be fabricated through the conventional casting method by utilizing the solubility gap between solid and liquid in pressurized gas atmosphere. However, there is a shortcoming that the pores are coarsened in the part farther from the chill plate in the ingot. In order to overcome such a shortcoming, we developed the continuous zone melting technique and successfully produced the lotus-type porous metals with even low thermal conductivity such as stainless steel and superalloys. Furthermore, from the viewpoint of mass production with low cost, we invented novel " continuous casting technique" . The molten metals dissolving gas are solidified continuously by passing through the mold cooled with chiller and thus, lotus-type porous metal plate as long as one meter was produced for short time. Sufficient uniformity of the porosity and pore size was obtained in such long porous ingots. This technique is prospective method for commercial mass production.

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Manufacture of Aluminum Foam via Powder Foaming Process

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The preparation of near-net shape aluminum foam samples and aluminum foam sandwich structures via powder foaming process are investigated with the emphasis on homogeneity improvement of the aluminum foam structures. The following researches carried out will be reported as follows:

1. Optimization of the foaming technology of Al and AlSi7 foams for obtaining homogeneous pore structures;
2. Investigation on the evolution of pore morphologies and cell wall microstructures during foaming;
3. Preparation of aluminium foam sandwiches (Al/foam/Al, Ti/foam/Ti, Fe/foam/Fe) and the investigation on the metallurgical bonding process between the face plate and the foam core during foaming;
4. Stabilization mechanism of liquid foam structures by SiC particle addition and the effect of SiC particle addition on mechanical properties of the foam;
5. Oxygen content increasement of Al powders by ball milling and its effect on stabilization of liquid foam structures;
6. Relation between the pore structures of the foam & sandwich and their mechanical properties (compressive strength and energy absorbing ability, bending strength and rigidity).