

Development of Porous Metal Materials and Applications

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Abstract

This paper described the state of art of porous metal materials, the typical manufacturing technologies and performances of sintered metal porous materials, with emphasis on the recent research achievements of CISRI in development of porous metal materials. High performance porous metal materials, such as metallic membrane, sub-micron asymmetric composite porous metal, large dimensional and structure complicated porous metal aeration cones and tube, metallic catalytic filter elements, lotus-type porous materials, etc, have been developed. Their applications in energy industry, petrochemical industry, clean coal process and other industrial fields were introduced and discussed.

Key words: powder metallurgy; porous metal materials; fabrication and application; filtration and purification

With the development of science & technology and the improvement on demand for industrial technique, membrane materials and its preparing technology has been rapidly advanced. CISRI/AT&M has developed the patent technology for fabrication of metallic membrane by means of powder metallurgy on the basis of nanometer powder. The filter precision of metallic membrane achieves to 0.03 μ m, and filter efficiency reaches to 99.999999%.

The demand for the accuracy and the handling capacity of material purification has been more and more increasing in modern industry including foodstuff, medicine, electronics and chemical industry, etc. Because the pore size of traditional sintered metal powder filter elements is more than 3 μ m, it is very difficult for the traditional sintered metal powder porous materials to meet the demand for the development of modern industry in filter accuracy or large flux. AT&M has developed the new type, high filter accuracy, large flux and sub-micro porous metal materials. The new type filter media is in multi-layer structure made up of reinforced layer, transition layer and operational layer. Of the three layers, the reinforced layer and transition layer act as strengthening, and the operational layer is thinner pore layer working as filtering. The new type sub-micro porous metal materials are provided with high filter accuracy. At the same time, the flow characteristic of the materials is improved greatly owing to the thinner operational layer. It shows excellent prospect that the new type porous metal filter media would be applied in modern industry.

The large dimensional, abnormality structural sintered porous metal materials are new direction to the development of porous metal materials. In comparison with conventional sintered metal porous materials, it puts forward the better demand and challenge for molding

technique, sintering technique and equipment to manufacture the large dimensional, abnormality structural sintered porous metal materials. At present, the new type materials are mostly produced by isostatic pressing technique in the world. AT&M has developed the large dimensional, abnormality structural sintered porous metal materials according to the need for engineering application. The company has manufactured sintered metal powder cones with size up to $\phi 500 \times 1000$ mm by means of isostatic pressing and vacuum sintering technique. AT&M has still developed large dimensional, exterior surface smooth porous filter tube used for gas particulate cleaning. As a kind of key components, such materials have already been used in Shell coal gasification engineering.

Catalytic porous materials are a kind of special functional materials with active elements distributed in the porous material. They inherit structural and functional characteristic of porous material and have excellent fluid permeable ability, high specific surface and controllable fluid distributed characteristic and combined with the catalysts the materials can improve chemical reaction, enhance productivity, reduce energy consume and simplify processes. In the past few years, AT&M developed porous catalytic filter materials based on metallic porous material. Advanced porous metallic catalytic distillation component can displace conventional CDTECH to be applied in catalytic distillation process. Advanced catalytic filter material can be used for gas cleaning at high temperatures and post treatment of diesel off gas. It can remove poisonous component such as NO_x, VOC, etc and catch particulate simultaneously

Being a new technique appearing no more than ten years, GASAR is invented by Ukraine scientist Shapovalov, and is believed to be a revolutionary technics of fabricating porous

metal. It not only has superior properties than conventional materials such as little stress concentration, high mechanical performance, excellent thermal conductivities, but also have better mechanical performance than other porous materials of same chemical component. The porosity, pore size and distribution can be controlled by adjustment of technical parameters. Such materials can be applied not only in car, aviation & aerospace, architecture, etc as lightweight structural material but also in water-cleaning, sound controller as functional material.

In the past few years, there appear many metal porous materials producers with rich techniques and advanced equipment in china. They will accelerate porous metal applications in industrial fields and improve technical progress of related industrial fields. In addition, the shift of foreign manufactures towards China will bring many chances and challenges to Chinese porous metal producers and as a result will push forward the development of metallic porous material. In the future, Metal porous material will be developed towards high precision, large flux, multi-functional and large dimensional and abnormality structural.

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