Sintered Fe_3Al Intermetallic - A New Filter Element for Hot Gas Filtration

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Abstract

Gas filtration at high temperature from industrial processes offers various advantages such as increasing process efficiency, improving heat recovery and materials resource recovery, etc. At the same time, it is an advanced environment protection technology. This paper describes a newly developed metallic filter element. The manufacturing process of sintered Fe_3Al metallic powder and the mechanical and filtration characteristics of this filter element were investigated. In this work, the phase constituent changes of the Fe_3Al powder during sintering were studied. The newly developed filter elements were found to have excellent corrosion resistance, good thermal resistance, high strength and high filtration efficiency.

Keywords: sintered metal powder, Fe_3Al filter element, high temperature gas filtration

1. Introduction

Gas filtration at high temperatures has great potential applications in different industry fields, such as in Integrated Gasification and Combined Cycle (IGCC) power generation process, in chemical and petrochemical industry, in ironmaking and steelmaking processes, in ceramic industry, in incinerator units, etc. High temperature filtration is a key component for effective utilization of hot gas resources.

Since the 1990's, extensive research works have been devoted to the development of advanced metallic filter elements, as metallic materials exhibit good thermal resistance, high strength and toughness, good heat conduction ability and therefore good thermal shock resistance. Furthermore, some metallic materials, such as 310S, Fe_3Al intermetallics and FeCrAl alloy, etc. have exhibited good chemical corrosion resistance in oxidizing and sulphidizing atmosphere, which makes them good candidates as filter elements for hot gas filtration. This paper describes a newly developed metallic filter element - sintered Fe_3Al intermetallics. The manufacturing process of sintered Fe_3Al metallic powder and the mechanical and filtration characteristics of this filter element were investigated.

2. Experimental and Results

Fe_3Al intermetallic porous materials were developed through powder metallurgy process. Through high temperature sintering, filter elements reveal high strength and good filtration efficiency. Table 1 shows the characteristics of sintered Fe_3Al filter elements or tubes.

Fe_3Al materials have excellent thermal resistance, even at 700℃, the filter material still maintains a tensile strength of about 30～40 Mpa(Fig.1), which is higher than that of ceramic filter materials (around 20Mpa). Fig.2 shows the weight gain of sintered porous Fe_3Al in oxidizing atmosphere. It is clear that after a short initial period, the corrosion rate of Fe_3Al porous materials slows down quickly.

Table 1 Characteristics of sintered Fe_3Al porous materials

Properties / Filter element	Pore size (μm)			Permeability	Porosity	Thickness	σ_b
	R_{max}	R_{ave}	R_{min}	m^2	%	mm	MPa
FeAl -150– 1	12.7	9.6	7.8	$2.08x10^{-12}$	44.3	3~5	130
FeAl -100– 1	17.5	14.0	12.3	$2.65x10^{-12}$	45.1	3~5	100

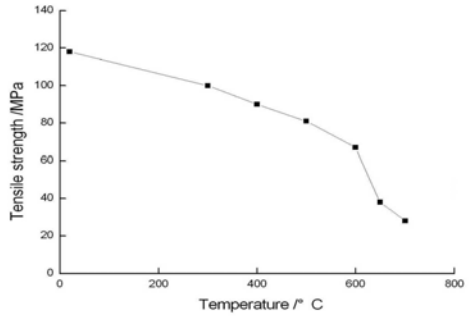

Fig.1. Tensile strength of sintered Fe_3Al at high temperatures

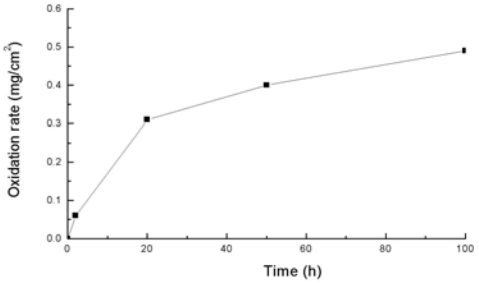

Fig.2. Weight gain of Fe_3Al in oxidizing atmosphere(750℃, air)

3. Summary

1) Fe_3Al porous materials were manufactured through powder metallurgy process. Sintered Fe_3Al porous materials have high strength and good gas permeability.
2) Fe_3Al sintered porous materials have good thermal resistance which may work up to 600 ~ 700℃. The porous material also have excellent corrosion resistance in oxidizing and sulphidizing atmospheres at high temperatures.

4. References

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