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Formation of Structure at Thermodiffusion Chroming of Porous Permeable Materials Based on Iron Powder

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Abstract:: In this article, the formation of porous permeable iron based composite structure chromized via thermodiffusion method. Chromized porous permeable iron based composites were done by two kind of thermodiffusion process: first composite samples chromized after sintering (AS) and second composite samples were chromized during sintering (DS) process by pumped and filled with chromium gas in cylindrical chamber. Macro and microstructural properties of the samples were analyzed by optical microscopes NBS-1 and MIM-7, respectively. It is observed that totally change of microstructure due to not perfectly done for the AS samples even 3 h chromizing processes. During preparation AS samples gas phased of chromium moved through the channels of porous composite and deposited on walls of channels. After increasing of keep time the thermodiffusion process is started. It means diameter of the channels became smaller or closed after thermodiffusion process of the composite samples. In another hand, the porous samples structures were changed. In an opposite chromizing results were observed for the DS samples and microstructures were investigated.

Keywords: *Porous materials, permeability, thermodiffusion, iron powder, sintering, porous composites, diffusion, chromizing gas phase.*

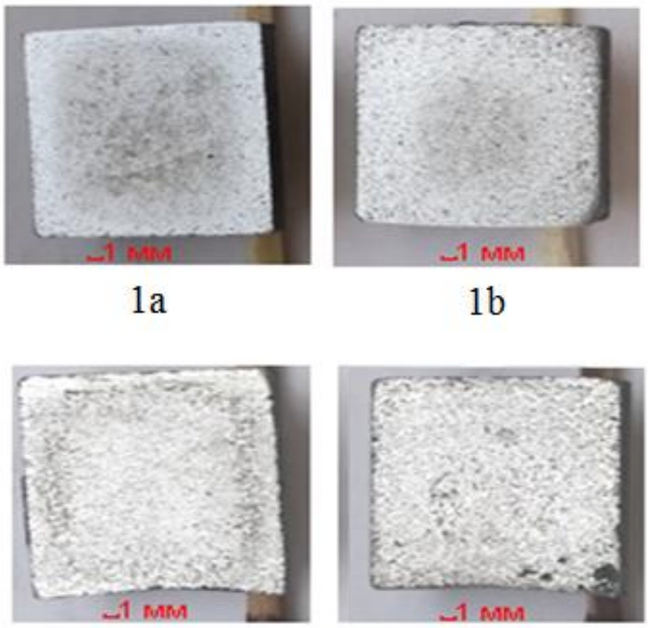
I. INTRODUCTION

At present time, porous composites has a great attention due to its wide range technology based applications, such as filtration water, oil, gas, stop the sand powders, preparation of catalizators and anodes, make smooth out of liquids and etc. [1-8]. In addition, porous composite materials are used at medical purposes such as a screw tooth, bond etc. [9]. Cr-coated Fe porous composites have a several parameters that can show its physical-mechanic properties. These parameters are porosity, volume, porosity of channels, and condition of the channels, absorption and it is covering of surface area. It is very important mention above parameters to fabricate a composite material from powder technology until force of the press, hot press temperature, hold time and sintering atmosphere [10-12]. Most of the Cr coated Fe based porous filters fabricated by powder technology due to its stability under high pressure, high temperature, and corrosion resistant properties [13,14]. Disadvantage of this composite is material cost and influence of product purity by broken filter parts through the channels. Cold pressed particle surfaces do not recycle oxide layers during sintering process. However, some of the particle surfaces or the sintered porous materials coated with oxide layers. If this oxide layers will sit on the surface or near to the surface area brought from the ground during the filtering process. In addition, this will effect to the filtering efficiency.

II.METHODS AND MATERIALS OF RESEARCH

However it is needed to study on chromizing of the iron powder based permeable materials. To solve this problem need to make chromium gas phase for diffusion the chromizing method of porous materials. Thermodiffusion method is very popular in production of chromizing of iron based powder materials such as C, N, Si, Cr and etc. This method is able for both chromizing materials: before and after sintering porous materials. In this case important is to focus on physical mechanical properties of the porous materials [15]. Influence of the thermodiffusionchromizing on porosity of iron based permeable structures were published in [16 - 18] several research articles. A few studied works are focused on both sintering and thermodiffusionchromized samples [16,17]. We can suppose that published results similar with samples which as sintered and then chromized by thermodiffusion process. Also microstructural results proofs that published in [18]. However porosity of the structure is not fully completed. In other hand results should be different for the both chromizing process. At first (as sintered and then thermodiffusionchromized) Process chromizing gas phase move through porous structure.

At the second process (both sintered during chromizing) gas phase moves through pressed and stressed particles. In case of first process chromizing controlled by porosity and parameters of chancls [16]. In a second process chromizing should be controlled by size of powders, shape and pressing force. To compare this 2 method chosen same iron powders, pressing forces and shapes for the prepare samples. Samples were obtained both methods with size 16mm×16mm. And 2 different pressing forces. Before chromizing some shaped samples sintered by 3 cycled furnace under hydrogen atmosphere. Then all sintered and shaped samples set in the vacuum chamber for the chromizing. Chromizing were done one hour and three hours at 1150°C [17]. To keep same condition used same chamber. All the preparation process given in table 1. To analyze chromized samples were polished [18]. Microstructures of the polished samples were given an image 1. Microanalysis of the samples that both process were showed different results (see in figure (1(a), 2(a)).



1a 1b 2a 2b

1 – figure. Macrostructure of thermodiffusionchromized samples: 1a – after separately sintered, samples were chromized during 3 hours, pressing pressure P = 4 t/sм2; 1b – the same but pressure P = 2 t/sм2; 2a – Sintering process was carried out for 3 hours simultaneously with chromization, P = 4 t/sм2; 2b – the same but pressure P = 2 t/sм2

Figure 1(a) and 1(b) shows for the chromized samples after sintered. In this results chromium diffused into Iron were showed 2mm and 4mm deep for the figure 1(a) and 1(b) (see in fig 1).

But these samples were not chromized fully for the both pressed 3 and 2 t/sm2. To clearly understand mechanism of the thermodiffusionchromizing prepared permeable samples at 1 and 3 hours were polished. Microstructures of the samples at chromized after sintering were given in figure 2.

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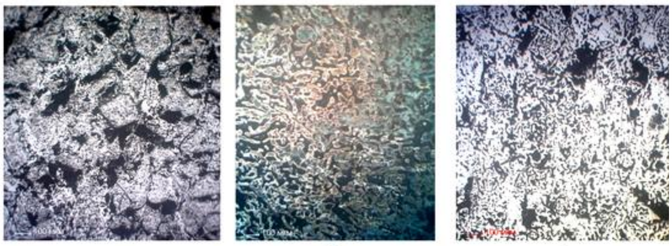
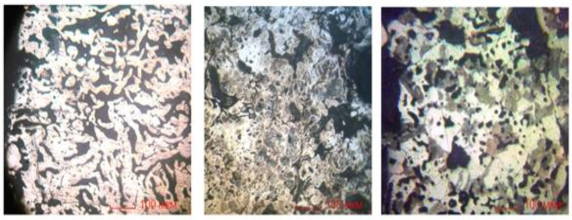


2 – figure. Macrostructures of thermodiffusionchromized samples after sintering, (x200): a – sintered; b – thermodiffusionchromized for 1 hour; c – thermodiffusionchromized for 3 hours.

III. DISCUSSION

Microstructures of the 1 hour chromized samples show that chromium gas phase sit on the walls in channels. After increasing of chromizing time that chromium phase diffused into channel walls. These results almost similar to microstructural analysis as described in [16-18]. Microstructures of the thermodiffusionchromized during sintering were shown in figure 3. In analysis of pressed under 4t/sm2. And chromized during 1 hour sample showed 3 kind of chromized area. In first figure 3 (a) observed 1-1,5mm thick chromium diffused area. Figure 3 (b) shows that chromium in 2-2,5mm deep. Third area chromium phase through till center of the samples. But it was observed not fully chromized area (see in figure 3(c)).



3 – figure. Microstructures of the thermodiffusionchromized samples during sintering (x300): a – the first area (edge of sample); b – the second area; c – the third area (the center of sample)

IV. CONCLUSION

The results of above analysis shoved that gas phase of chromium moved through pressed (stressed) particles for the chromized during sintering process compared to chromized after sintering samples. Appearance of the chromium necks between particles were obtained during process. It was found that chromium fully diffused into center of the samples during 1 hour. As a conclusion the diameter of the channels of porous and permeable materials were changed for the sintered and then themodiffused samples. In another hand thermodiffusionchromizing were not infuses to the diameter or on he parameter of the samples sintering and chromizing both porous were done at the same time. In addition sintered and then chromizrd samples channel diameters were decreased and closed during thermodiffusionchromizing process. An opposite chromizing during sintering channels of the porous samples were not open during porous and gas phase of chromium were through the particle centers.

Table 2 - Calculated PSNR values for the proposed and existing methods

3.3 Comparison by Quality Index using Eye Perception

Table 3, depicts the Quality Index of the proposed and existing methods using eye perception for all the five images. The proposed method's eye perception quality index for all the five images was 3, proving the noise removal process employed by the proposed method is achieved better-quality when compared to existing methods.

REFERENCES

1. 1. Rogov V.A., Soloviev V.V., Kopylov V.V. New materials in mechanical engineering: Textbook. - M.: RUDN University, 2008 - 324 p.
2. New materials. Call authors. edited by Yu.S. Karabasov. - M: • MISIS •. - 2002 - 736 p.
3. Powder materials science. Andrievskiy R.A. - M.: Metallurgy, 1991 .-205 p.
4. 4. Belov S. V. Porous permeable materials. –M .: Metallurgy, 1987.-335 p.
5. 5. Vityaz P.A., Kaptsevich V.M., Sheleg V.K. Porous powder materials and products from them. - M: Higher school, 1987. - 161 p.

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ISSN: 0193-4120 Page No. 635 - 638

6. 6. Powder metallurgy. Materials, technology, properties, areas of application: Reference / I. M. Fedorchenko, I.N. Frantsevich, I.D. Radomiselskiy et al .; Ovt. ed. I.M. Fedorchenko. - Kiev: Science, Dumka, 1985 - 624 p.
7. Structural powder materials / I. D. Radomyselsky, G. G. Serdyuk, N.I. Shcherban. - K .: Technika, 1985 - 152 p.
8. Powder metallurgy and sawn coatings: Textbook for universities. V.N. Antsiferov, G.V. Bobrov, L.K. Druzhinin et al. M.: Metallurgy, 1987. 792 p.
9. Shibryaev B.F., Pavlovskaya E.I. Ceramic-metal filtering elements. M., "Engineering", 1972, 120 S.
10. Processes of powder metallurgy. In 2 vols. T.2. Powder materials and products from them: Textbook for high schools / Libenson G.A. Lapatin V. Yu., Komarnitsky G.V. - M .: • MISIS •. - 2001 - 368 p.
11. Vityaz P.A., Kaptsevich V.M., Sheleg V.K. Porous powder materials and products from them. - M: Higher school, 1987. - 161 p.
12. Powder metallurgy of steels and alloys / DzneladzeZh.I., Schegoleva RP, Golubnva LS, Rabinovich EM, Borok B.A. - M., "Metallurgy", 1978, 264 p.
13. Metal powders and powder materials: reference book / BN. Babich, E.V. Vershinina, V.A. Glebov and others; under the editorship of Yu.V. Levinsky. - M .: ECOMET, 2005 .-- 520 p.
14. Material science: Textbook for high schools / B.N. Arzamasov, V.I. Makarova, G.G.; Under the general ed. B.N. Arzamasova, G.G. Mukhina. - 3rd ed., Stereotype. - M.: Publishing House of MSTU. N.E. Bauman, 2002 .-- 648 p.
15. V.S. Pugin, O.D. Bussel, P.A. Kornienko, N.P. Pavlenko, N.Ch. Pioro The effect of diffusion chromium plating on the porous structure of an iron-based material // Powder Metallurgy, 1977. No. 12. - P. 62 - 65.
16. V.S. Pugin, P.A. Kornienko, N.P. Pavlenko, O.D. Bussel. Diffusion chromium plating of porous permeable materials from sintered iron powder // Powder Metallurgy, 1979. No. 8. - P. 32 - 34.
17. V.S. Pugin, P.A. Kornienko, N.P. Pavlenko, O.D. Bussel. The effect of diffusion silicification on the porous structure of an iron-based material // Powder Metallurgy, 1980. No. 4. - P. 102 - 104.
18. Shakirov Sh. M., KhasanovG.Sh. Obtaining composite cermet materials from mill scale // Composite materials, 2006. -№2. -P. 37-40.