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# Structure of FeAl-$Fe_xAl_y$ composite powders for thermally sprayed coatings

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The structure of composite powders with FeAl intermetallic phases after the SHS process is presented. The microstructure and morfology of FeAl-$Fe_xAl_y$ composit powder were determinated. The chemical and phases characteristic of this composit powder were obteined by EDS and X-ray analisys. Results confirm the role of SHS process for the formation of modified iron aluminide powders.

## 1. INTRODUCTION

Intermetallic phase powders from Fe-Al, Ni-Al and Ti-Al systems can be produced by alloy spraying methods in a process of mechanical alloying, diffusion saturation or self-propagating high-temperature synthesis [ ]. The choice of the synthesis method determines the structure and properties of powders. It is recommended to obtain composite powders or ones with a complex phase composition in a high-temperature synthesis. The main purpose of the research undertaken was to produce powders from the FeAl system which would have a structure and phase composition enabling their application in selected methods of composites and coatings production.

## 2. MATERIAL AND TECHNOLOGICAL CONCEPTION

On the basis of an analysis of literature data and own research, a material conception has been assumed which, with its assumptions of the powders' chemical and phase composition, was a new one compared to the existing information about the produced powders containing intermetallic phases from the Fe-Al system. Bearing in mind the hardness and high brittleness of the FeAl phase formed in the range 23.3 – 55 aluminium at.-% in the mixture, it was decided that research should be done on producing a powder which would have high aluminium content together with plastic phases or plastic phases with ones reinforcing the Fe-Al alloy matrix. It has been assumed that two basic types of powders shall be produced: FeAl-$Fe_xAl_y$ – $Al_2O_3$ and FeAl- $Fe_xAl_y$. It has also been assumed that the composite powder will contain phases of high dispersion.

After analysing the methods of production of intermetallic phases powders, an activated self-propagating high-temperature synthesis was chosen [ ]. The advantages of this method of obtaining powders with a predetermined phase composition will allow the formation of

powders with a required composition and properties. In the literature, there is no information about the above-mentioned powders produced by means of this method. There is a technological difficulty with the production of powders having a matrix reinforced with aluminium oxide. The main research purpose was to produce the above-described powders.

## 3. SCOPE OF RESEARCH

The research programme covered:

- development of a material and technological conception of powders production
- development of the technological parameters for the synthesis of the powders
- determination of the structure of powders obtained in laboratory and industrial research
- determination of the areas of the powders future application.

## 4. RESEARCH RESULTS

The structure and phase composition of powders synthesized in the ASHS process are presented in Figure 1-2. The produced powders are characterized by a morphology typical of those obtained in a high-temperature synthesis (Figure 3). The diffraction pattern in Figure 4 confirms the over-structure of the Fe-Al phase. The FeAl- $Fe_xAl_y$ powders are characterized by a specific structure in which both hard and soft, more plastically phases are present. In case of applying the synthesized powders for thermal spraying of coatings, one should assume that a modification with aluminium oxide will allow increasing the coatings' resistance under conditions of abrasive and erosion wear.

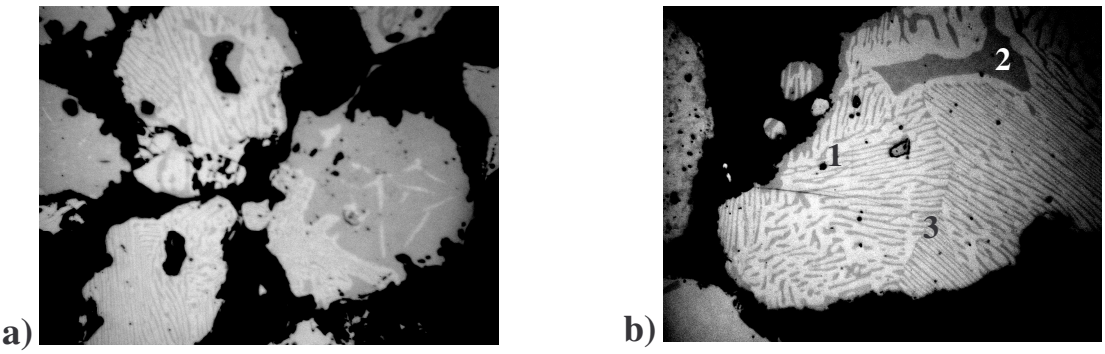


Figure 1. Structure of composite powders with intermetalic Fe-Al dispersive phases

## 5. CONCLUSION

In the research on obtaining powders which contain intermetallic phases from the Fe-Al system, the earlier developed ASHS method was used. The powder of an intermetallic alloy with a lamellar eutectic structure can be defined by the formula: FeAl-$Fe_xAl_y$. The chosen conditions and technological parameters of obtaining the powder in laboratory or production conditions are proper, which has been confirmed by the X-ray radiography examination.

Obtaining a composite powder with aluminium oxide required a correction of the parameters for production conditions. Powders of a predetermined structure can be used in the processes of thermal spraying of coatings, sintering or formation by means of plastic working methods.

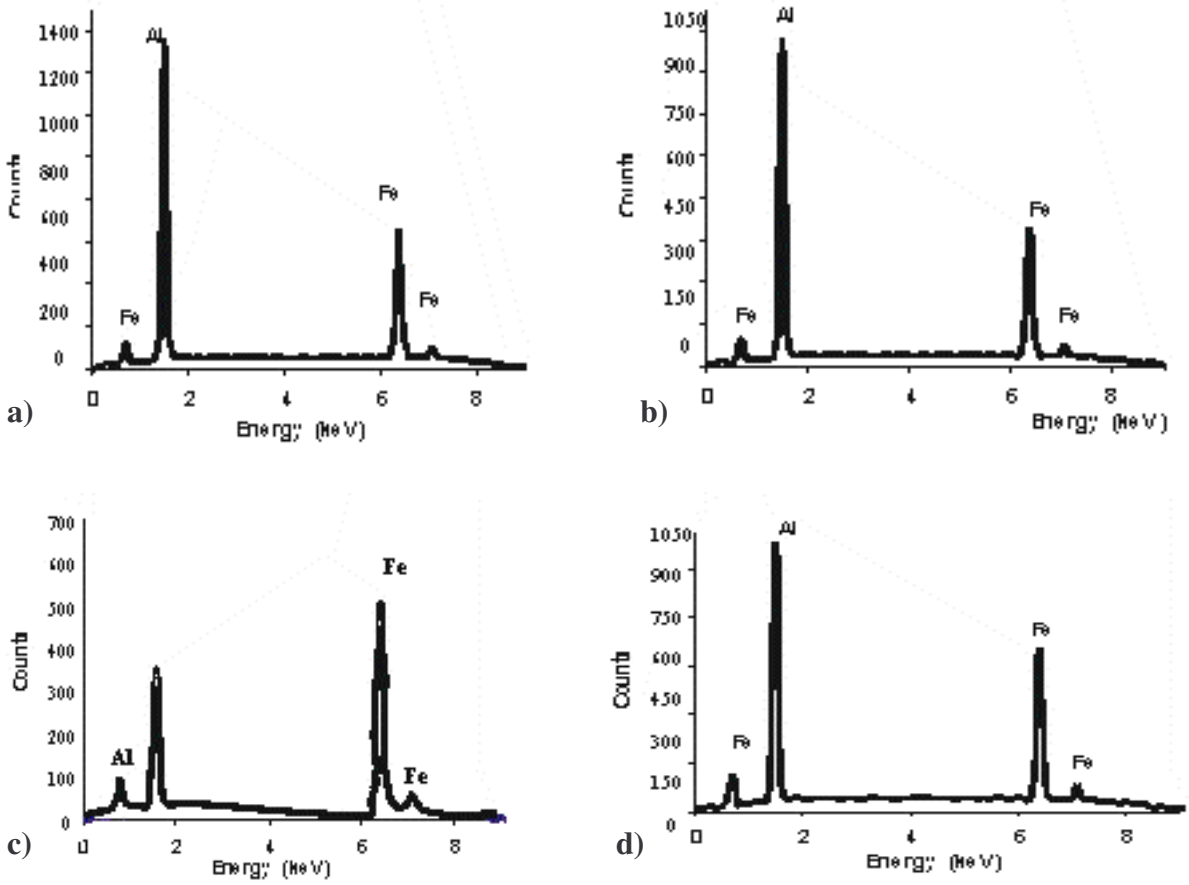


Figure 2. EDX analisys of FeAl-Fe$_x$Al$_y$ composite powders:
a) - chemical composite from fig. 1a;
b) -d chemical composite of 1-3 points from fig. 1b

Table 1
Chemical composition of FeAl-FexAly composite powder

| Chemical composition | Fe | | Al | |
|---|---|---|---|---|
| | At % | Wt % | At % | Wt % |
| counts | 43,70 | 61,63 | 56,30 | 38,37 |
| Point 1 | 43,78 | 61,71 | 56,22 | 38,29 |
| Point 2 | 70,02 | 82,86 | 29,98 | 17,14 |
| Point 3 | 33,85 | 51,43 | 66,15 | 48,57 |

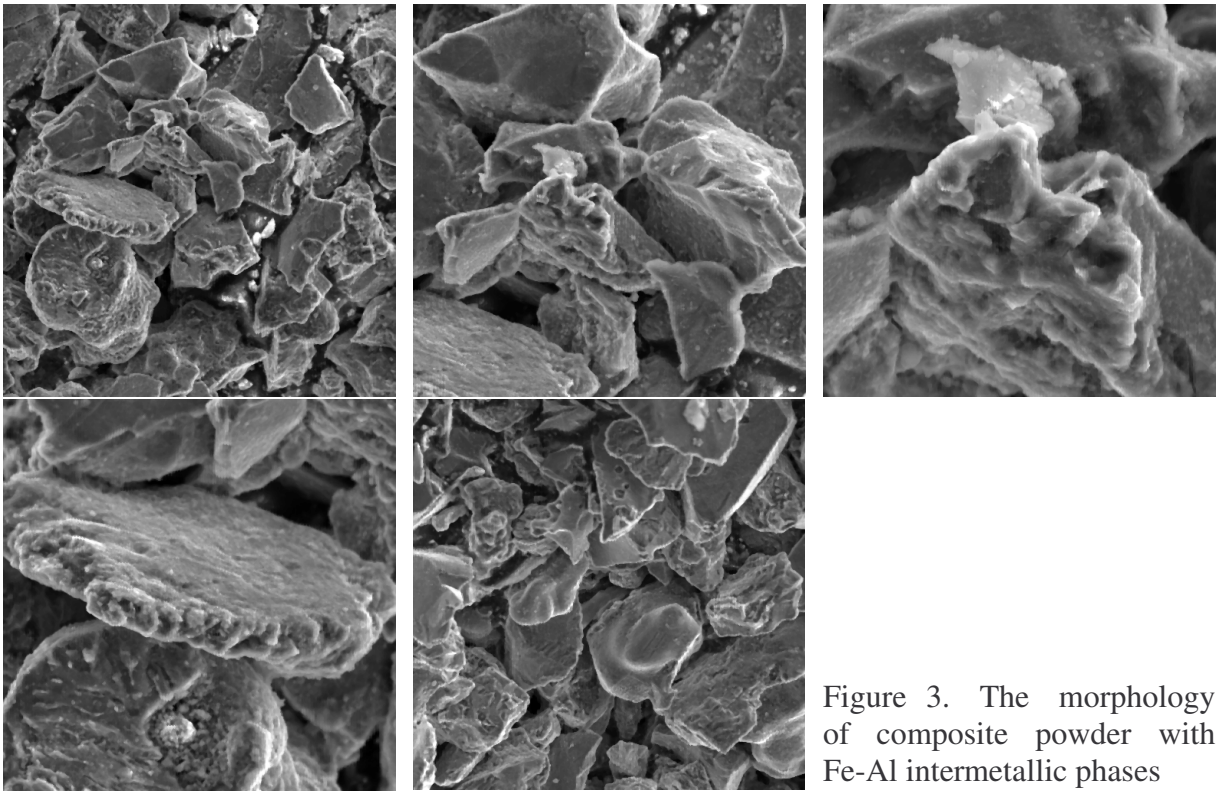

Figure 3. The morphology of composite powder with Fe-Al intermetallic phases

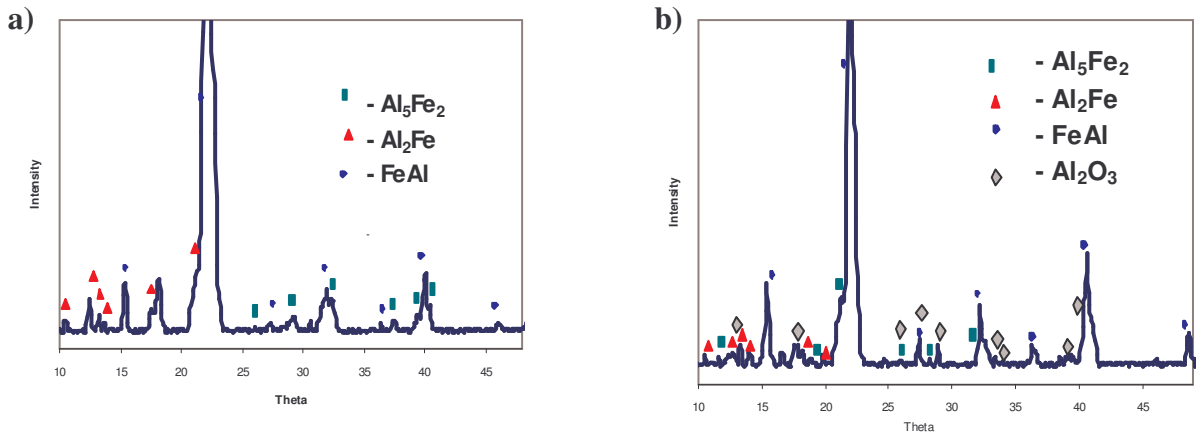


Figure 4. X-ray analisys of composite powders: a) FeAl- $Fe_xAl_y$; b) FeAl- $Fe_xAl_y$ -$Al_2O_3$

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