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ADVANCED MATERIALS FOR AEROSPACE, COMPOSITE WITH FINE STRUCTURE

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Abstract: *Metal or ceramic composites with reinforced metal or ceramic materials consist the future for material class. The paper propose to present the results and the conclusions of a few researches in this field.*

Keywords: *composite, nano-composite, metallic materials*

1. INTRODUCTION

Mixture of several components, whose properties complement each other, resulting in a material with properties superior to those specific to each component part, defines the composite material.

Delineate the difficulties arising in composite materials based on the idea (often used as an objection) that, practically, almost any material is a composite material are extremely rare because no impurities, no defects, alloying elements or not impregnated, coated, treated superficially covered. The distinction is harder to do if their material is taken into account the atomic and molecular scale.

Depending on the structure of materials can be classified as :

- a) crystalline materials:
- polycrystalline(ferrous and nonferrous alloys);

- crystal (metals, oxides, carbides, nitrides, semiconductor and optoelectronics)
- Microcrystalline (alloys subjected to heat treatment such as hardening);
- b) semicrystalline (polymer);
- c) amorphous and glassy materials (metallic and nonmetallic);
- d) composite materials:
 - Each component dispersed;
 - Pressed powder aggregate;
 - Associated material, obtained by surface coating with metallic or nonmetallic substances;
 - Layered (obtained by assembling successive or simultaneous).

The superiority of composite materials compared to conventional materials, resulting in Figure 1.1, which is the ratio of tensile strength and density with temperature.

As shown, metal matrix composites are superior to conventional ones, but with lower properties of ceramic composites

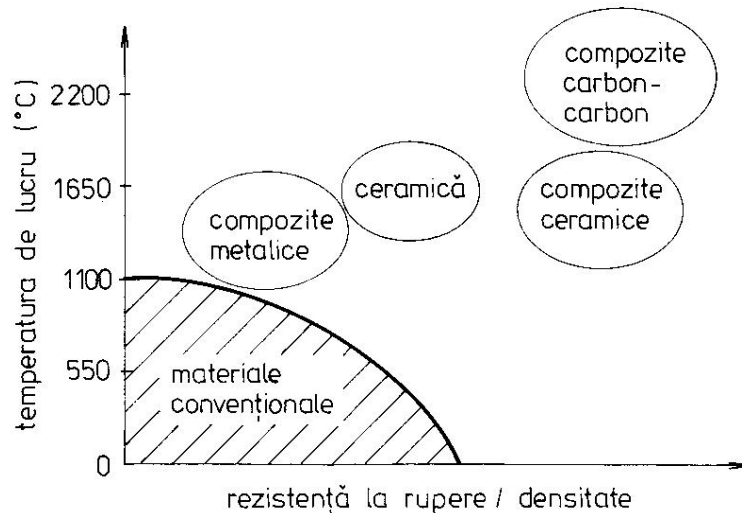


Fig. 1.1 The place they occupy between the composites materials resistant to high temperatures

Resistance-temperature composite materials, corrosion or oxidation is determined primarily by the nature of the matrix. In general, the matrix is deformable composite material, having a lower strength than the composite material. Matrix choice is based on the purpose and the possibility of producing composites. Components operating at high temperatures should not occur expansion differences between the matrix and dispersed component (if metal or alloy cermet). In case of major mechanical stress, modulus reinforcement material must be greater than the matrix material to provide load transfer between components. A very strong adhesion between the composite constituents favor this transfer, leading to increased fragility.

Concerns about the world in terms of technology, have led to technologies shaping next generation of ceramic-metal composite materials:

- by polyphasic sintering process (or cosinterizare) under load or no load;
- by impregnating the porous ceramic with molten metal mass;
- by deposit of very fine particles (nano) on various supports (metal, ceramic composite were even) by electrodeposition method, the adsorption, diffusion, thermochemical treatments, etc.. In-depth analysis of

processes, it is found that any of the methods used to manufacture composite aggregates and other processes specific phenomena. The result is a composite manufacturing process engineer pluricomplex with specific physical, chemical, thermal, electrical.

In theory composites seem to be two basic models, namely, model Naidich Weyl respectively. Principle schemes for the two models are presented in figures 1.2 and 1.3. Due to the high polarizabilității of oxygen anions and their large size compared with metal cations, can be considered in accordance with Weyl's model that the surface oxide layer is a double-anion, figure 1.2.

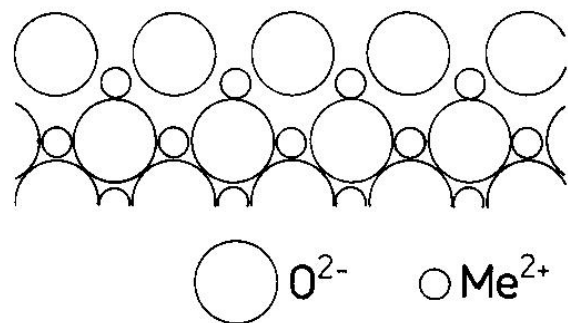


Fig. 1.2 The surface structure of the Weyl phase ceramic-metal oxides.



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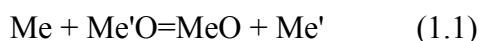
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In the absence of oxygen in the bath metal compound $Me^{2+}O^{2-}$ formation involves the deployment of a reaction:



Chemical interaction contribution to the adhesion energy increases with increased production of free energy of reaction (1.1),

thus increasing the liquid metal affinity for oxygen. Naidich's model - Fig. 1.3, on the situation in which the metal bath is dissolved oxygen. It forms a compound with the metal surrounding $Me^{2+}O^{2-}$, which is adsorbed at the interface due to electrostatic attraction forces of Me^{2+} cation and the anion layer, the surface oxide paticle.

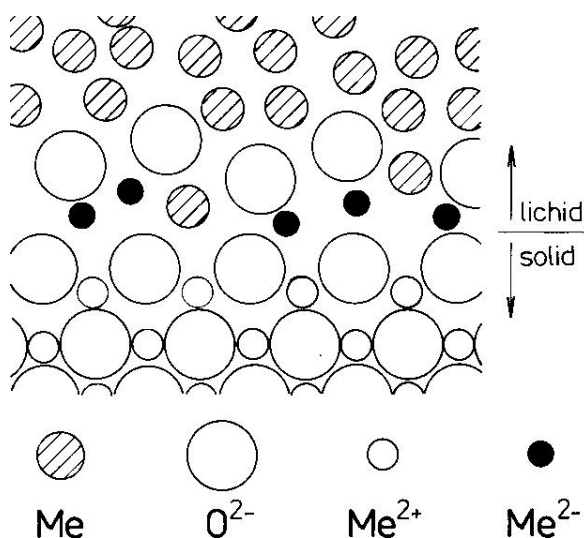


Fig. 1.3 Naidich's model for liquid metal-oxide ceramic interface.

The increased metal affinity for oxygen, the solubility of the compound $Me^{2+}O^{2-}$ drops and activity at the interface increases. For sufficiently high oxygen content in the melt formed a continuous layer of metal oxide to the substrate surface. Adhesion energy is approximately equal to the energy required to destroy the ionic bonds between the two oxides.

Active metals forming strong links with ceramic materials, making them usable

for metal or alloy elements. Customize these models for making ceramic-metal composite is presented in figures 1.4 and 1.5.

Figure 1.4 is represented schematically by the solid solution formation of connections, Cr_2O_3 , reduction occurs, followed by the appearance of metallic chromium exudate, or substitution unoxidised metal chromium and chromium metal-forming solution (in this example nickel-chromium).

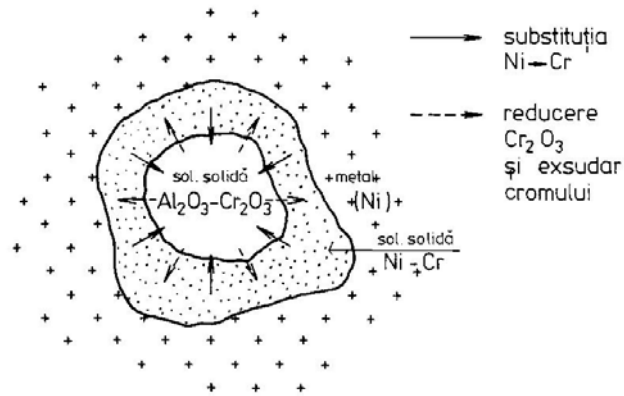


Fig. 1.4 The scheme links the formation mechanism of solid solution.

Another link between the formation mechanism involves the formation of a cermet components spinels intermediate phases, as in the case of cermet (Fe, Ni, Co) - Al_2O_3 .

Figure 1.5 is represented schematically by the phase spinels link formation mechanism.

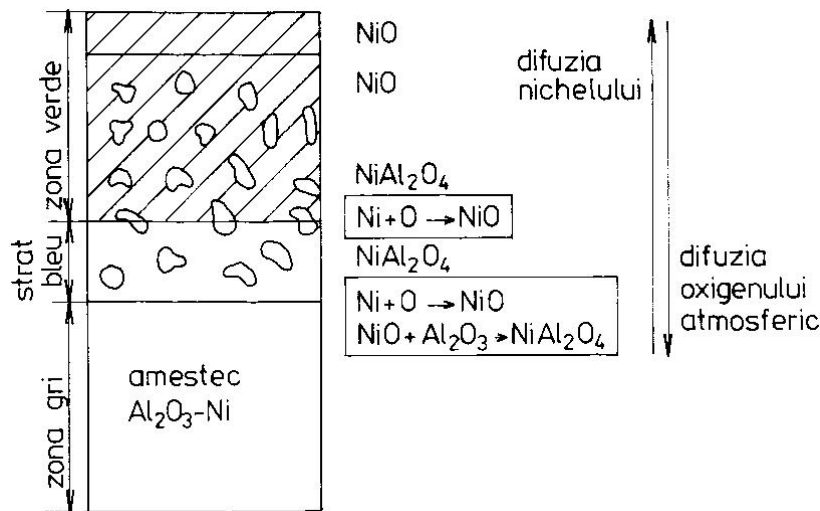


Fig. 1.5 Formation mechanism of the phase diagram link spinels

2. Experimental research results

Distribution of aluminum in the ceramic composite made by impregnating aluminum can highlight thin section due to metal opacity, it appeared black on photomicrography.

Aluminum content throughout the ceramic wall thickness is not uniform. Entering the ceramic mass takes place only until a certain depth, and its amount decreases from the periphery inwards (fig. 1.6, 1.7, 1.8).

Microscopically the mass is noted ceramic aluminum penetration through the pores open and total or partial substitution of mineral

phases that contain silicon (mull, quartz, vitreous mass).

Marginal area of the composite structure is microcrystalline, consisting of an opaque mass, a uniform, which contains rare relics of corundum (Fig. 1.6a, 1.7a).

Composition, the interior wall mass content is remarkable decrease opaque (metal) and ceramic mass relics increase the structure and composition can be recognized (Fig. 1.6b, 1.7b, 1.8, and b).



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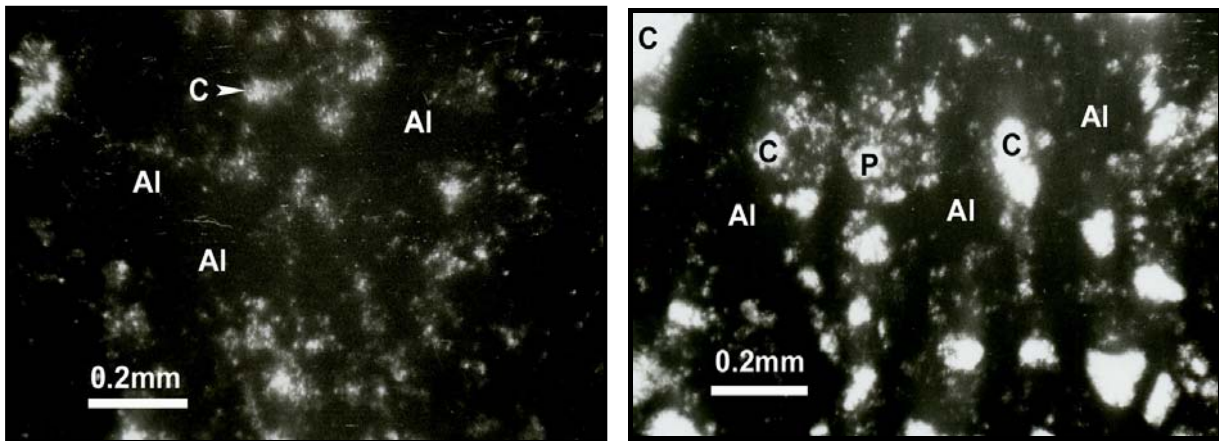


Fig. 1.6. Composite - ceramic-aluminum product R1 + Al (transmission polarizing microscopy). Microcrystalline structure consisting of an opaque metal mass (Al) ceramic relics occur \pm matrix composed of tiny pores (P)(see b). Most clastelor are represented by corundum (C). The texture is compact. a) The exterior of the composite - 1N; b) central area of the composite - 1N.

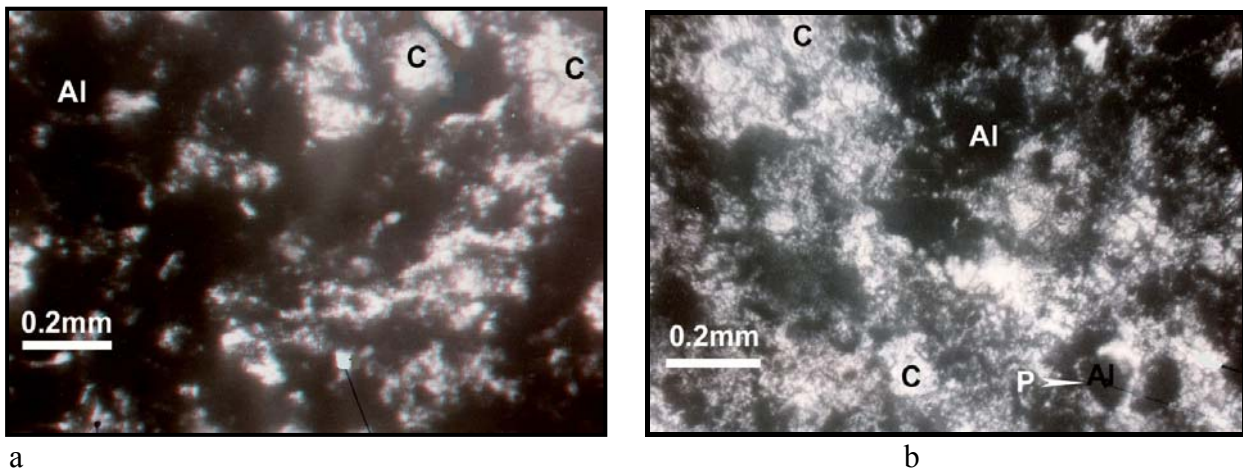
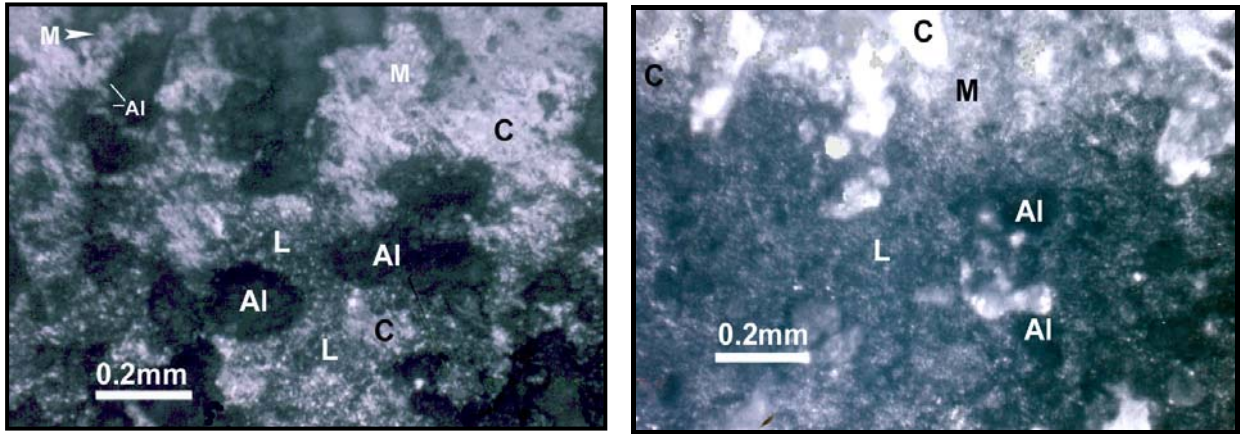


Fig. 1.7. Composite - ceramic-aluminum product R2 + Al (transmission polarizing microscopy). Microcrystalline structure consisting of an opaque metal mass (Al) occur relict crystals formed ceramic matrix \pm sometimes with pores (P) (see b). Most clastelor are represented by corundum (C). The texture is compact. a) The exterior of the composite - 1N; b) intermediate zone of the composite - 1N.



a
 Fig. 1.8. Composite - ceramic-aluminum product R2 + Al (transmission polarizing microscopy). Microcrystalline structure consisting of an opaque metal mass (Al) ceramic relics occur in aggregates of crystals formed and the matrix (L). Most clastelore are represented by corundum (C), reporting to mull (M). The texture is compact. a) The term close to the center. Observe the unit mull corrosion by aluminum (top left) - 1N; b) central area of the composite - 1N.

Metallographic microscopy study of the structure allowed the predominantly metallic phases. Metallographic preparations were

made from all sorts of evidence: impregnated with aluminum, nickel and copper. Microphotographs were conducted on samples and free of damage caused by chemical attack (Fig. 1.9 and 1.10).

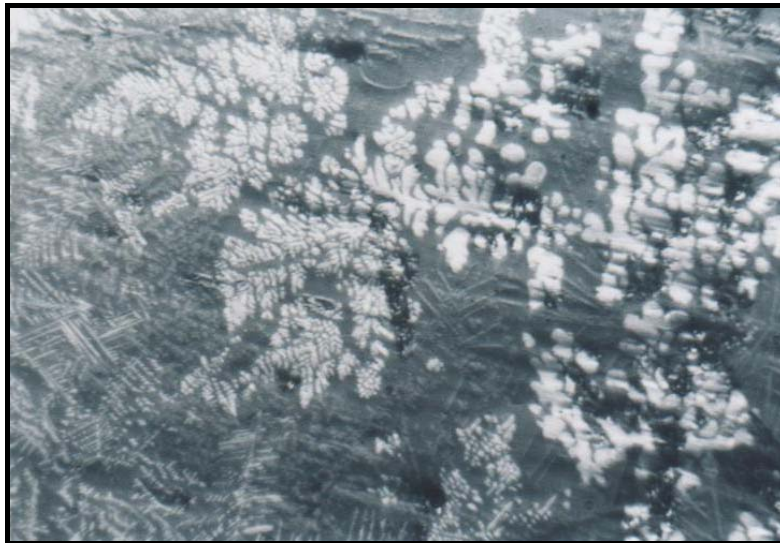


Fig. 1.9. Table R1 ceramic impregnated with copper zone of transition between the coated and impregnated; 250X



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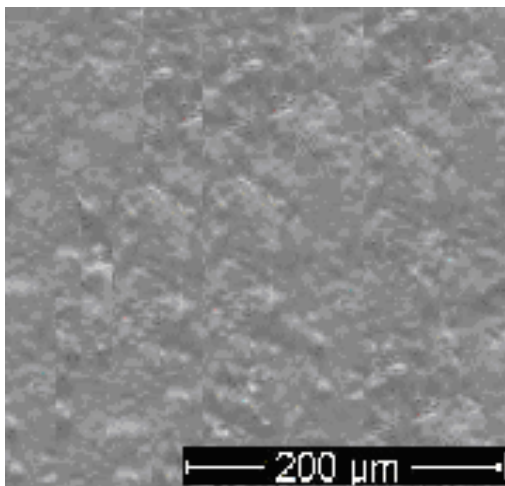
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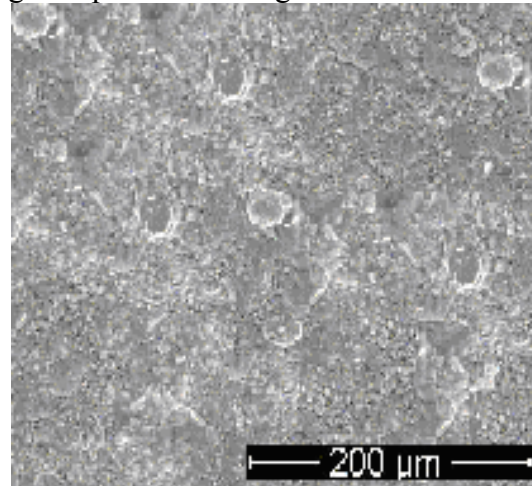


Fig. 1.10. Sample appeal $\text{FeCl}_3 + \text{HCl}$ chemical mass-R1 ceramic impregnated with Cu, marginal zone; 250X

SEM microstructures surface for Cu- Mo coatings are presented in fig.1.11



a



b

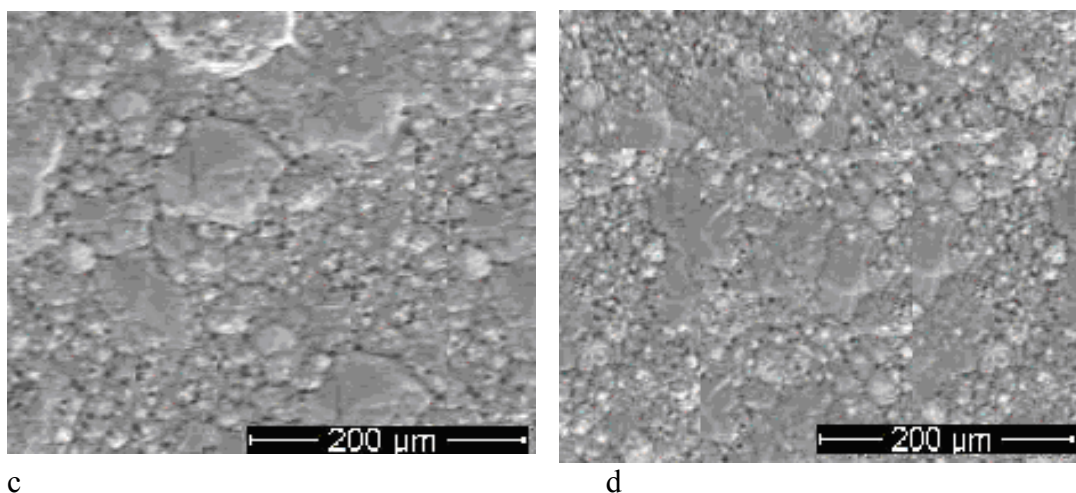


Fig. 1.11. SEM surface microstructures for Cu-Mo coatings size $3\mu\text{m}$, 90min, 500rpm, $i=1,5\text{ A/dm}^2$: a) pure b) Cu-Mo, 20g / L, c) Cu-Mo 40g / L, d) Cu-Mo, 60g / L, magnification x 500

CONCLUSIONS

From the figure for nano composites made by electrodeposition, our analysis reveal their fine structure.

Metallographic microscopy study of the structure allowed the predominantly metallic phases highlighting the fact that metal has penetrated into the pores of the ceramic material.

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