СЕКЦИЯ «ПРОМЫШЛЕННЫЙ ДИЗАЙН, СТРОИТЕЛЬСТВО, АРХИТЕКТУРА»

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THE INFLUENCE OF ALUMINA CONTENT IN CU-AL_2O_3 POWDER ON THE PROPERTIES OF COLD SPRAYING COATINGS

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Introduction

The effect of the content of aluminum oxide particles in copper powder on the structure and strength of adhesion of coatings, obtained by the method of cold gas-dynamic spraying, is in the focus of attention in this work.

Experiment content. Coating preparation parameters.

The main factors, influencing the particle velocity, are: gas pressure, gas temperature, feeding speed, spraying particle characteristics and spraying distance, etc. Table 1 displays experimental parameters for this experiment. Figure 1 shows micro morphology of Al_2O_3 and copper powder, mixing according to certain proportion. In this experiment preparation quality of Al_2O_3 content is respectively 5, 10, 15, 20 and 25%, five different ratio, spray in cold spraying equipment to the substrate surface. This experiment selects the copper, aluminum and steel base materials, and sandblasting processing. Table 2 shows the hardness of the base (substrate) materials.

Table 1 – Experimental parameters of cold gas-dynamic spraying

Experimental parameter	**Numerical values**
Gas pressure, MPa	0.5-0.8
Gas temperature, ^{0}C	300-400
Spray particle size, μm	30-40
Send the powder gas	compressed air

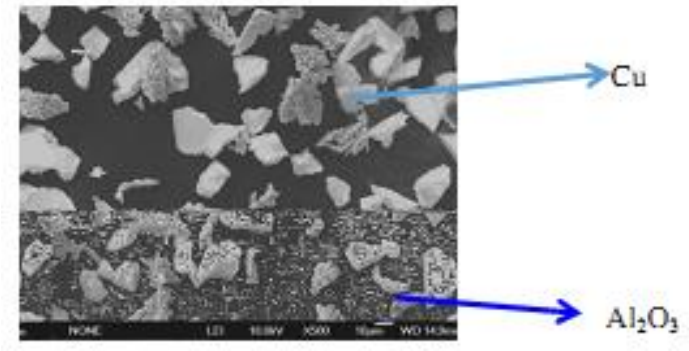


Figure 1 – Micro morphology of Al_2O_3 and copper powder

Table 2 – Substrate type and hardness

Type of the substrate material	copper	aluminum	steel
hardness HV	92.4	84.3	135.5

Coating performance testing. The thickness of the coating

The thickness of the sprayed coating, completely determining the strength of its adhesion to the substrate, is due to a number of technological parameters: the type of the powder to be sprayed, the spraying regime, and the number of cycles. In this paper, the influence of the content of aluminum oxide in the deposited copper powder on the thickness of the formed coating is investigated.

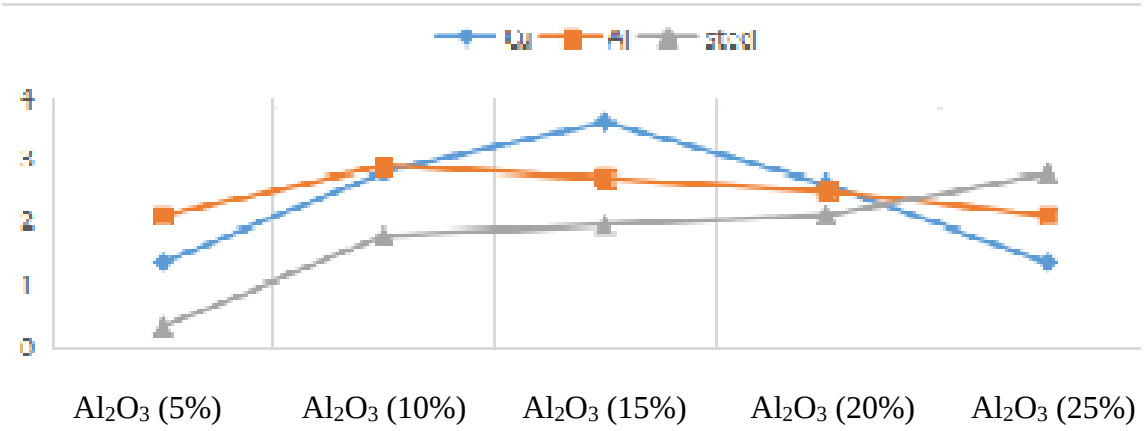


Figure 2 – Effect of the content of aluminum oxide in the deposited copper powder on the thickness of the coating, applied to different substrates (copper, aluminum, steel)

The Figure 2 shows, that all kinds of powder are available on copper, aluminum and steel substrate to achieve a good deposit. With the remaining parameters of the deposition process, the maximum coating thickness in one pass is achieved with aluminum oxide content in the range of 10 to 20%.

Bonding strength. In all the experiments, a minimum adhesion strength of the coating was found when the content of aluminum oxide additives in the copper powder was about 15% (Figure 3). The destruction occurred at the interface between the coating and the substrate, and not over the coating itself. This shows that the cohesion strength in the coating is large enough, that is, the grasping of the particles with the copper particles of the matrix takes place.

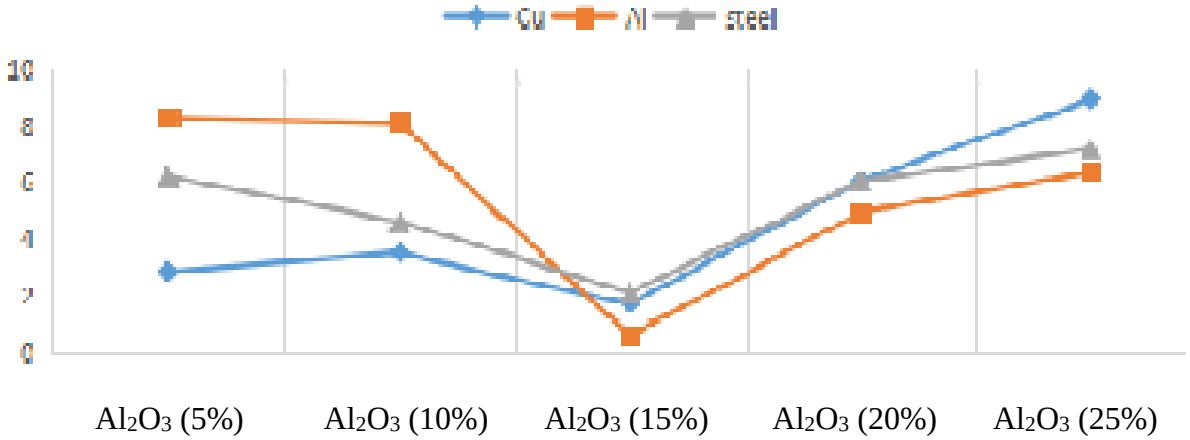


Figure 3 – Effect of the content of aluminum oxide in the deposited copper powder on the adhesion strength of the coating, applied to different substrates (copper, aluminum, steel)

The content of aluminum oxide in the copper coating. During the deposition of the coating, a certain amount of alumina particles is reflected off the surface of the substrate, which explains the decrease in the ceramic content in the formed coating. According to the coating interface microstructure pictures by using ImageJ software can accurately calculate the content of the ceramic phase in the coating (table 3).

Table 3 – he losses of Al_2O_3 during the deposition of the coating

% of Cu in the powder	75	80	85	90	95
Cu substrate	0.21	4.94	10.69	9.73	15.58
Al substrate	2.96	7.45	12.02	15.88	21.15
Fe substrate	1.95	6.11	10.36	17.13	14.61

Relationship of coating thickness and bonding strength. Adhesion strength of the copper coating, applied to different substrates (copper, aluminum, steel), versus different coating thicknesses is shown at figure 4.

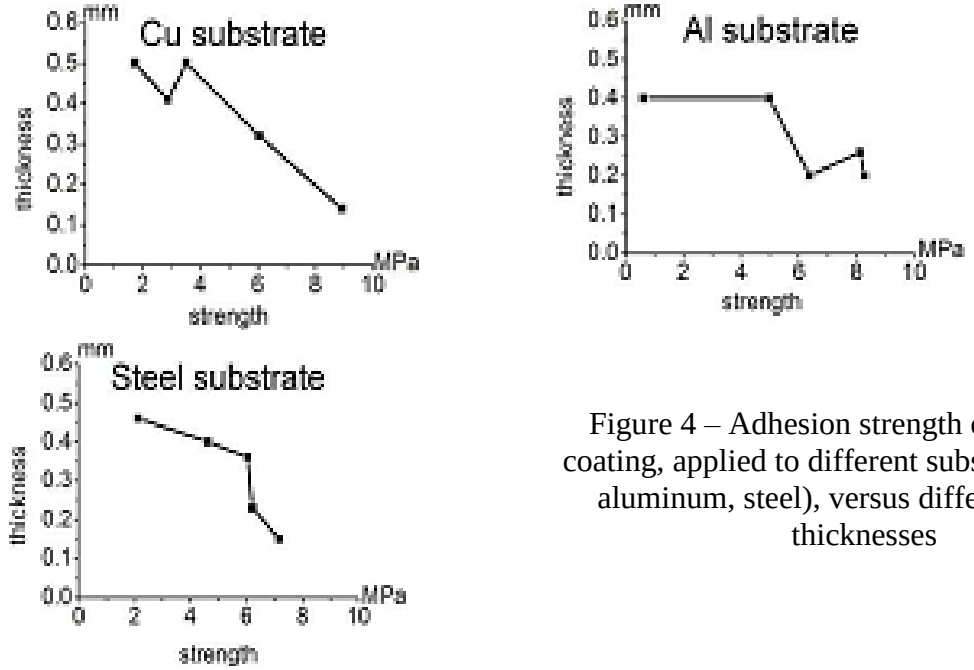
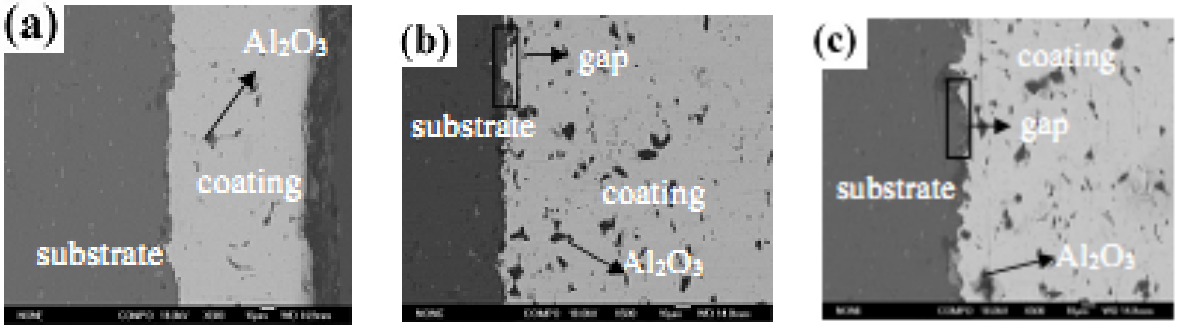


Figure 4 – Adhesion strength of the copper coating, applied to different substrates (copper, aluminum, steel), versus different coating thicknesses



The thickness of coatings, mm: 0.20 (a), 0.26 (b) and 0.40 (c)

Figure 5 – Microstructure of a copper coating, applied to an aluminum substrate

The microstructure of coatings of various thicknesses has been studied by SEM metallographic analysis and is shown in Figure 5. When the coating thickness for 0.20 mm, almost no pores between coating and substrate. As the thickness of the coating increases, there is a tendency to increase the porosity.

Conclusions. The cold gas dynamic spray was used to prepare the Al_2O_3-Cu alloys coating on Al, Cu and steel substrate with the mixture of pure Al_2O_3 powder and pure copper powder. The effect of different contents of ceramics in a powder mixture on properties of the coatings is analyzed. The results showed that at relatively high substrate hardness, different ratios of ceramics did not significantly affect the bond strength.

Al_2O_3-Cu coating on Al substrate can get largest thickness when the mixed powder includes 10% Al_2O_3. Al_2O_3-Cu coating on Cu substrate can get largest thickness when the mixed-powder includes 15% Al_2O_3. Al_2O_3-Cu coating on steel substrate can get largest thickness when the mixed-powder includes 25% Al_2O_3.

Al_2O_3-Cu coating on Al substrate can get maximum bond strength when the mixed-powder includes 10% Al_2O_3. Al_2O_3-Cu coating on Cu substrate can get maximum bond strength when the mixed-powder includes 20% Al_2O_3. Al_2O_3-Cu coating on steel substrate can get maximum bond strength when the mixed-powder includes 25% Al_2O_3.

The more the coating thickness - the lower the bond strength.

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BIM ТЕХНОЛОГИИ В СОЗДАНИИ АРХИТЕКТУРНЫХ СООРУЖЕНИЙ

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Abstract. *Information modeling is one of the leading brunches in designing sphere of possible building objects. In this article the main advantages of BIM technology while creating architectural constructions are described.*

BIM (Building Information Modeling или Building Information Model) – информационное моделирование здания или его информационная модель [1].

Информационное моделирование здания – один из подходов к строительству объекта, в процессе проектирования которого рассматривается вся информация о нём. Сбор, актуализация, документальная фиксация и комплексная обработка всей архитектурной, конструкторской, технологической, и экономической информации о здании со всеми ее зависимостями и взаимодействиями помогают рассматривать объект и всё что к нему относится как единое целое (рис. 1).

Рисунок 1 – Информационная модель здания в предполагаемой окружающей среде

3D модель любого строительного объекта неразрывно связана с информационной базой данных, в которой можно присвоить каждому элементу модели дополнительные свойства и атрибуты. Особенностью информационного моделирования является то, что строительное сооружение по факту проектируется как единый объект, а изменение одного из параметров может повлечь за собой автоматическое преобразование остальных компонентов, которые с ним связаны.

Эксплуатация BIM технологий предоставляет огромное количество возможностей для работы с объектом на каждом этапе его создания – начиная от разработки проекта и заканчивая дальнейшей его эксплуатацией после того, как строительство будет завершено.