formed during the specified oxygen-free combustion. The hardening of the hardened layer to the base alloy is also obtained by metallurgical means.

Conclusions. As a result of the experimental design, the authors conducted a number of search works, worked out the design documentation of the experimental complex for dust protection and doping of parts in the process of plasma spraying, made prototypes and conducted their operational tests.

The combination of PSS and SHS in one operation allows to solve a whole set of technical problems for obtaining high-strength carbidostal-type materials and solid alloys on the alloy surface. The new complex technological process allows to increase the worn surfaces of parts of machines, devices and devices to a depth of up to 500 microns with materials having high mechanical, service and technological properties.

Literature

1. Zhiguts Yu.Yu., Legeta Ya., Golovka Yu. Development of SHS technology / Prospects of world science: XV intern. scientific and practical conf., 30 July 2019 - 7 August 2019: Materials of the conf. – Sheffield: Science and education LTD, 2019. – №. 8. – P. 61 - 63.

2. Zhiguts Yu.Yu., Opachko I.I., Opachko (jun.) I.I. Conditions of effective deposition of superhard materials in medicine / Deutscher wissenschafts-herold» ("German Science Herald"). "Inter GING", – № 2 (15). Gamel′n. 2016. – С. 49 - 51. ISSN (print) 2509-4327.

УДК 621.74.04:669.112.22

YU. ZHIGUTS[1], V. LAZAR[2], B. KHOMIAK[2]
[1]Uzhhorod National University,
[2]Mukachevo State University

MODERN TECHNOLOGIES OF CREATION OF HIGH-HARD SURFACES

The laser surface hardening (*LSH*) of metals was discovered in 1965. It has won strong positions in technology of metals [1]. Nowadays in the whole world hundreds of patents have been awarded to branch inventions including those dealing with combination of *LSH* with *SHS* (self-propagating high-temperature synthesis). One of them [2-6] is dedicated to combining of *LSH* with *SHS* (self-propagation high-temperature synthesis). Formerly *SHS* was combined with other technologies of surface hardening of components [1-6].

The impotent problem within the *LSH* is the decreasing of the losses of beam energy because of its reflection by the surface of metal under machining. In the given investigation, as well as in the invention [1], the mixture of powders *Ti* (65%), carbon in black state (18%) and *Fe* (14% by mass) were used in the role of light-absorbing paint. The mixture was damped by solution of 2 % latex in gasoline, and then it was put on the surface of stalls of mark 10 and 20 and was dried in an open air, forming the layer 80, 200 or 500 mkm thick. Thermochemical calculations showed that in such a mixture practically all *Ti* interacts, thanks to non oxygen combustion, with carbon, forming the carbide *TiC*. The seer plus of carbon and very small account of *Ti* alloy the iron forming liquid steel of condition, which under fast cooling turns into troostite in layers of 80 mkm thick.

In typical microstructure of metal in cross-cut of harded layer got under density og power 17 W·m^{-2}, diameter of „spot" − 0,4 mm, the speed of scanning 12 min/s and expense of argon (for the defense of *Ti* from air oxidation) − 0,5 *l/s* is shown. The thickness of alloy is ~500 mkm. This layer consists of ~50% particles *TiC* and ~50%(by volume) of metal link-instrumental carbon steel of type "У8".

The investigations made have proved that the microhardness of carbides *TiC* is higher than the hardness of steel almost 10 times. Thus, in the given work we managed to organize the *SHS* process in comparatively thin layer thanks to using of *LSH* technology simultaneously for solving of two tasks: for heating, flashing and carbonating of an iron; for flashing *Ti* particles and its „combustion" in carbon with forming of carbides *TiC*.

The adiabatic temperature of non-oxygen combustion of equiatomic mixture *Ti-C* equals to 3200 *K*. The real temperature of combustion of selected mixture 68% (% in mass particles) is more than 1850 *K* that provides the formation of hard-liquid dross (*TiC*-melding) with the large interval liquids solid us. The formation of dross instead of one-phase alloy influences positively on the quality of surface of hardened layer after its full growing hard and cooling as well as on supporting of this layer even on inclined planes.

It is important to note that in the mentioned non oxygen combustion none of nonmetallic phase and its including is formed. Welding of hardened layer with basic metal is obtained automatically „metallurgic ally", excluding the necessity of soldering or other methods of connecting one alloy (e.g. instrumental) with other (e.g. with the basis of cutting tool).

The substitution of a part of iron powder by the powder of carbon ferrochrome (e.g. 12%*Fe*+2%*FeCr* instead of 14%Fe in the formulae of *SHS* mixture) allows to get layers of carbidosteel with the link not in the shape of steel "У8" but from alloyed steel "X12" which after fast cooling of these layers thanks to accelerated drain of heat to cold metal of the basis gets austenite-martensite-carbide structure. In the process of work of the instrument such metal link additionally grows hard thanks to pre-transforming of austenite into martensite and getting older of the later one. The hard of such a carbidosteel reaches *HV*1400 (14000 MPa).

The substitution of a part of iron in the *SHS*-mixture by ferrochrome increases greatly corrosion resistance of carbidosteel and decreases its oxidizing wear in the process of its exploitation. The substitution of carbon in *SHS*-mixtures by the powder is also long-range. The same effect is obtained also with the substitution in another field of hot machining of metals namely the using of *SHS*-reactions for inmoulding process (modification within of the form) in casting manufacturing.

The substitution of carbon in *SHS*-mixtures by the powder of boron is also perspective. In such a case it is possible to reach the liquidus-solidus interval to 1500 *K*, that in other technologies it is practically impossible to meet. Thus, while the above mentioned method on the one hand high refractory diborides TiB_2 and CrB_2 (with high hardness) are formed and, on the other hand, very easily melted complex eutectics are formed.

Conclusions: 1. Combination of *LSH* and *SHS* in one operation allows to solve the whole complex of technical problems connected with producing of materials with high hardness like carbidosteels and hard alloys on metal surface. 2. Evolution of inner chemical heat in *SHS*-mixtures allows to decrease the power of laser radiation. 3. New complex technological process allows to build up wearied surfaces of parts of machines and devices to the high of 0,5 mm.

Literature

1. Жигуц Ю.Ю., Лазар В.Ф. Технології отримання та особливості сплавів синтезованих комбінованими процесами. - Ужгород: Видавництво «Інвазор», 2014. – 388 с.

2. Zhiguts Yu.Yu., Legeta Ya., Golovka Yu. Development of SHS technology / Prospects of world science: XV intern. scientific and practical conf., 30 July 2019 - 7 August 2019: Materials of the conf. – Sheffield: Science and education LTD, 2019. – №. 8. – P. 61 - 63.

3. Zhiguts Yu.Yu., Opachko I.I., Opachko (jun.) I.I. Conditions of effective deposition of superhard materials in medicine / Deutscher wissenschafts-herold» ("German Science Herald"). "Inter GING", – № 2 (15). Gamel'n. 2016. – С. 49 - 51. ISSN (print) 2509-4327.

4. Zhiguts Yu.Yu., Kopej V.B. The use combined technologies to strengthen surfaces // Прогресивні технологіїї в машинобудуванні PTMУ-2019: матеріали доп. 8 міжн. наук.-техн. конф. 4 – 8 лютого 2019 р. – Івано-Франківськ. – Яремче, 2019. - С. 64-65.

5. Zhiguts Yu.Yu., Legeta Ya., Golovka Yu. Development of SHS technology // Prospects of world science –2019: XV intern. scientific and practical conf., 30 July 2019 - 7 August 2019: Materials of the conf. – Sheffield: Science and education LTD, 2019. – №. 8. – P. 61 - 63.

6. Zhiguts Yu.Yu., Legeta Y., Krajnjaj I. Equipment for integrated technologies of plasma spraying and SHS // The 1st International scientific and practical conference "Eurasian scientific congress" (January 27-28, 2020) Barca Academy Publishing, Barcelona, Spain. 2020. – P. 197-201.

УДК 65:164

ЗАРІЧНА О. В.
ДВНЗ «Ужгородський національний університет»

ОСОБЛИВОСТІ ВПРОВАДЖЕННЯ СУЧАСНИХ СИСТЕМ УПРАВЛІННЯ ЛОГІСТИКОЮ НА ПІДПРИЄМСТВІ

В умовах економічного розвитку та зважаючи на регулювання ринкових процесів важливим питанням сьогодення є розвиток бізнесу, який направлений на вирішення проблем, які виникають в ринковому середовищі. Не менш важливим серед них є проблеми пов'язані з формування ефективних методів та впровадження удосконалених процесів доставки товарів (продукції) від виробника до споживача. Саме вирішення цих питань покладено на таку сферу діяльності як логістика.

Відомі українські та зарубіжні економісти в області логістики, стверджують що правильно організована логістика на підприємстві сприяє набагато більшому задоволенні потреб ринку, адже вміле використання принципів та застосування ефективних методів управління нею допомагає планомірно виконувати поставлені завдання, обрати найбільш зручний метод доставки товарів або продукції до кінцевого пункту призначення, застосувати логістичну технологію, яка якнайшвидше допоможе підприємству виконати замовлення та запропонувати споживачу найбільш вигідні умови співпраці. Саме ці «напрямки» в економічній літературі описуються в загальній логістичній концепції, яка описує «7R» - сім правил логістики: товар має бути потрібний, відповідної якості, відповідної кількості, вантаж має бути