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IFToMM National Committee of Lithuania

The 9th International Conference

Mechatronic Systems and Materials

MSM-2013

Abstracts

Compiled by Olegas Černašėjus, Arturas Kilikevičius

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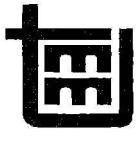

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This book constitutes the abstracts of Papers presented for the 9th International Conference on Mechatronic Systems and Materials – MSM-2013, which is being held in Vilnius from 01–03 July 2013 and organized by Vilnius Gediminas Technical University, Kaunas University of Technology, the Lithuanian Academy of Sciences, Opole University of Technology, Bialystok Technical University, the IFToMM National Committee of Lithuania.

The aim of the conference is to provide an opportunity to share information and facilitate co-operation in mechatronics and new materials and dissemination of current research results in this multi-disciplinary field. The task of the Conference is not only to acquaint participants with the works of scientists from different countries, but to expand their collaboration in the future.

The abstracts are printed without editing, but as presented by their authors.

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APPLICATION OF PULSE ELECTROMAGNETIC FIELD FOR JOINING OF POWDER DETAILS

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ABSTRACT

Nowadays pulse electromagnetic field effectively used in different manufacturing processes, such us stamping, forming, compacting of powders and welding, as well as production of powder coatings [1–7]. Pulse electromagnetic metal processing is based on physical processes that appear as a result of electrical discharge of capacitor or another device for electrical energy storage on the inductive load (inductor), where details is placed (Fig. 1).

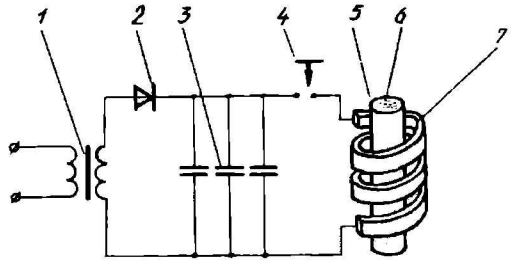


Fig. 1. Principal scheme of the pulse electromagnetic metal processing: 1 – transformer ; 2 – rectifier; 3 – capacitor's battery; 4 – discharger; 5 – rod; 6 – detail; 7 – coil

The main advantages of the pulse electromagnetic metal processing are follows: energy concentration on the certain areas of the detail, short-time process, and same equipment can be used to process of details of wide variety of different shape and dimensions. Plastic metallic materials with high electroconductivity, such as copper and copper alloys, aluminum and mild steel, can be most effective processed by pulse electromagnetic metal processing [6]. Some examples of permanent joining of metallic parts are given in [6, 7]. The aim of this work is to prove the possibility of the permanent joining of powder details by pulse electromagnetic field.

Experiments were carried out in Laboratory of Metal Forming Technology (West Saxon University of Zwickau, Germany) and in Laboratory of Powder Materials (Riga Technical University, Latvia). For joining the magnetic pulse forming machine BBC-60 was used (energy level 13,37 kJ, voltage 17 kV). The metallographic research and mechanical testing was carried out as well. The research object was samples from bronze and iron with 1,2% of graphite (Fig. 2). The inductor with sample is shown in Fig. 3. The macro and microsection of sample (outer diameter 32 mm, inner diameter 26 mm, width 25 mm) are shown in Fig. 4.

The electromagnetic force surface density is equal to difference of the pressure of pulse electromagnetic field on outer and inner surface of detail. During joining of the details the vector of electromagnetic force is directed to the side, when pulse electromagnetic field is weaker, i.e. in this case from the outer side of detail to the inner. If sample was produced from non-magnetic material the electromagnetic force surface density on the outer side of detail is close to 0, that's why the surface damages are not expected in contrary to other deformation methods, i.e. contact methods. Metallic powder details have residual porosity, but during joining by pulse electromagnetic field the additional compaction occur.

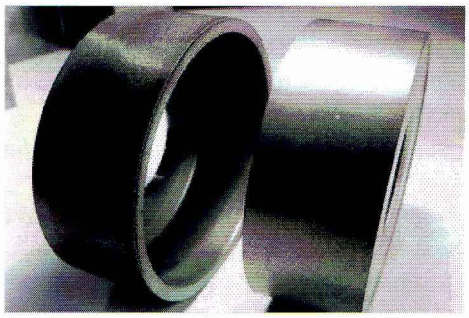


Fig. 2. Powder details before joining

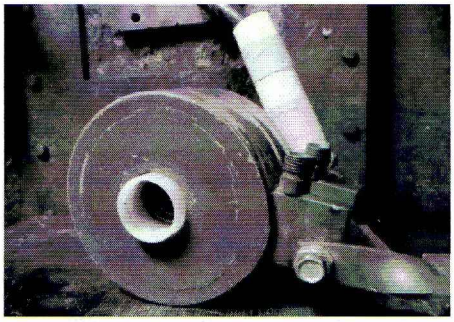
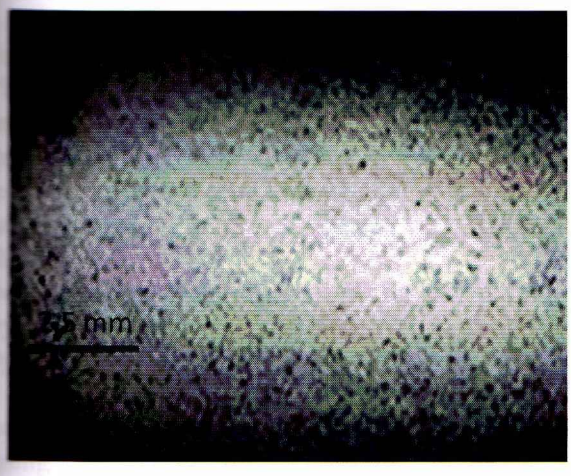
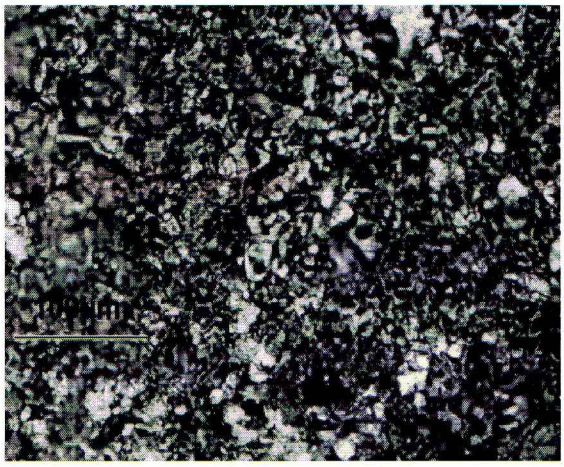


Fig. 3. Inductor with sample



a)



b)

Fig. 4. Macro (a) and microsection (b) of bronze-iron powder detail with 1,2% of graphite

RESULTS AND DICSUSSION

It could be concluded that the permanent joining of powder details by pulse electromagnetic field is an effective technological process that offers new possibilities in the field of the manufacturing of details from powder materials. It is possible to achieve the joining of details from different metallic powder materials and from dissimilar materials, when the inner detail could be produced from ceramics, for example, but the outer – from metallic powder.

Most effective the method of the permanent joining of powder details by pulse electromagnetic field when join powder details with relatively high copper content (more than 10%). It should be mentioned, that the machinability of powder details on the base of iron is lesser, but it can be increased by the increasing of the pulse magnetic field strength on the 105 A/m and higher and using discharge with frequency higher than 30 kHz.

The application of pulse electromagnetic field is most effective when thickness of powder details is in the range of 2 to 10 mm. It is caused by the effects connected with permeability the electromagnetic field into material.

ACKNOWLEDGEMENT

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