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(54) Benevnelse **METHOD FOR PRODUCING ELECTRIC TRIGGER ELEMENTS FOR PYROTECHNIC ARTICLES**

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Method for producing electric trigger elements for pyrotechnic articles

The invention relates to a method for producing electric trigger elements for pyrotechnic articles such as fuses or igniters.

Such a method is for example known from the prior art DE 102 40 053 A1.

Electric trigger elements serve to initiate a primary explosive as the first member of a fuse or igniter chain. For this purpose, the heat generated which is emitted by a resistor through which a current flows is used. The primary explosive is in direct contact with the electric resistor and is initiated by reaching its deflagration temperature. The electric resistor can be configured, for example, in the form of a wire.

The production method relates to a special form of igniter element wherein the electric resistor is formed by a thin metal film on an insulating substrate surface. Trigger elements of this type have been in general use for many years. The resistor layer made of a metal with a high specific resistance is applied by a physical vapor deposition (PVD) process onto the substrate (e.g. ceramic or glass) and, if required, is reinforced remote from the well-defined resistor area by a further layer of a material with a high electrical conductivity. The geometry of the resistor area is adapted to the requirements of the use, in particular, in relation to the resistance value and the initiation characteristic (e.g. the required current strength). In established production methods, the form of the resistor area (the thickness of which is given by the layer thickness of the metal film) is generated by laser material machining on each individual component.

Due to the influence of the high laser power during the material machining, undesirable material changes can occur at the edges of the laser cut. These material changes (of both geometrical and substantial types) have negative effects on the initiation characteristics of the resistor layer. Additionally, the individual machining of each trigger element is very time-consuming.

It is an object of the invention to provide a new method for producing initial elements based on PVD layers that enables a clean configuration of the edges of the resistor layers. It was also desirable to reduce the manufacturing costs.

According to the invention, the object is achieved by the method according to claim 1 in that

firstly a lacquer is applied by photolithography onto the substrate. This prevents a coating of the substrate in a large region, but leaves free a region of the substrate surface of precisely defined width. Subsequently, the PVD process is carried out on the lacquer and the substrate. By this means, an electrically conductive layer is produced between the two terminal poles of the trigger element. The lacquer is subsequently released from the substrate so that electrically non-conductive substrate and a resistor region of precisely defined width is obtained, through which the current can later flow from one terminal pole to the other. The thickness of the resistor layer is already set during the PVD process. In order to generate the length equally precisely, a photolithographic process is again carried out and a precisely defined region of the resistor strip is covered with lacquer. Subsequently, the entire substrate surface is covered with a relatively thick layer of readily conductive metal (e.g. by galvanic gilding). The application of the metal is configured so that in regions which have a bare substrate from the first photolithographic process, no metal adheres. Subsequently, the lacquer from the second photolithographic process is again removed. Due to the photoresist, a precisely defined region remains, which is formed only by the layer of metal with a high specific resistance. The first photolithographic process defines the width of the resistor layer and provides for insulation in the surrounding regions, the second process defines the length and the second layer provides for good electrical conductivity and good contact at the terminal poles. The PVD process itself defines the thickness of the resistor layer. For precise setting of the electric resistance, the PVD layer can originally be configured too thick and the thickness can be reduced by step-wise removal and thus the resistance can be set precisely.

If no reinforcement of the contact areas by additional readily conductive layers is required--the entire resistance geometry can be realized with a suitable photomask in a single lithographic process.

The special advantages of this method lie therein that very precisely defined edges of the resistor film come about and the material is homogeneous over the entire resistor area (no material changes due to point-wise heat effects as with laser machining). Furthermore, using photomasks, the resistor can be applied simultaneously for very many trigger elements and the parts must be separated at a later time point in the production process, which makes the process quicker and more economic than conventional methods.

Patentkrav

1. Fremgangsmåte for fremstilling av elektriske utløserelementer for pyrotekniske artikler, omfattende:

- i et første fotolitografisk trinn blir en lakk påført et elektrisk ikke-ledende substrat for å dekke substratet i et stort område og etterlate et fritt område av substratoverflaten av definert bredde;

- et elektrisk ledende lag påføres ved hjelp av en PVD-prosess på lakken og substratet slik at et elektrisk ledende lag mellom terminale poler av utløserelementet blir dannet;

- lakken frigjøres fra substratet slik at et motstands-område av definert bredde blir dannet, gjennom hvilket strøm kan gå;

- i et andre fotolitografisk trinn blir et definert område av mostandsstrimmelen med et fotomotstandsdyktig materiale slik at en definert lengde av motstandsområdet blir bestemt;

- hele substratoverflaten dekkes med et lag av lett ledende materiale, f.eks. en galvanisk forgylling, hvor påføringen av metallet er konfigurert slik at i områder som har et åpent substrat fra første fotolitografiske prosess, fester ikke noe metall seg;

- lakken fra andre fotolitografiske prosess fjernes, hvor et definert område gjenstår, definert av lakken, som blir dannet kun av metallaget med høy spesifikk motstand;

- hvor første fotolitografiske prosess definerer bredden av motstandslaget og fremskaffer isolasjon i de omliggende områder, hvor den andre fotolitografiske prosess definerer lengden og fremskaffer god elektrisk konduktivitet og god kontakt ved de terminale poler.

2. Fremgangsmåte ifølge krav 1,

hvor tykkelsen av motstandslaget blir bestemt av PVD-prosessen.

3. Fremgangsmåte ifølge krav 1 eller 2,

hvor det ledende lag påført ved hjelp av PVD-prosessen blir trinnvis fjernet slik at tykkelsen av motstandsområdet blir redusert og for å fastsette motstanden.