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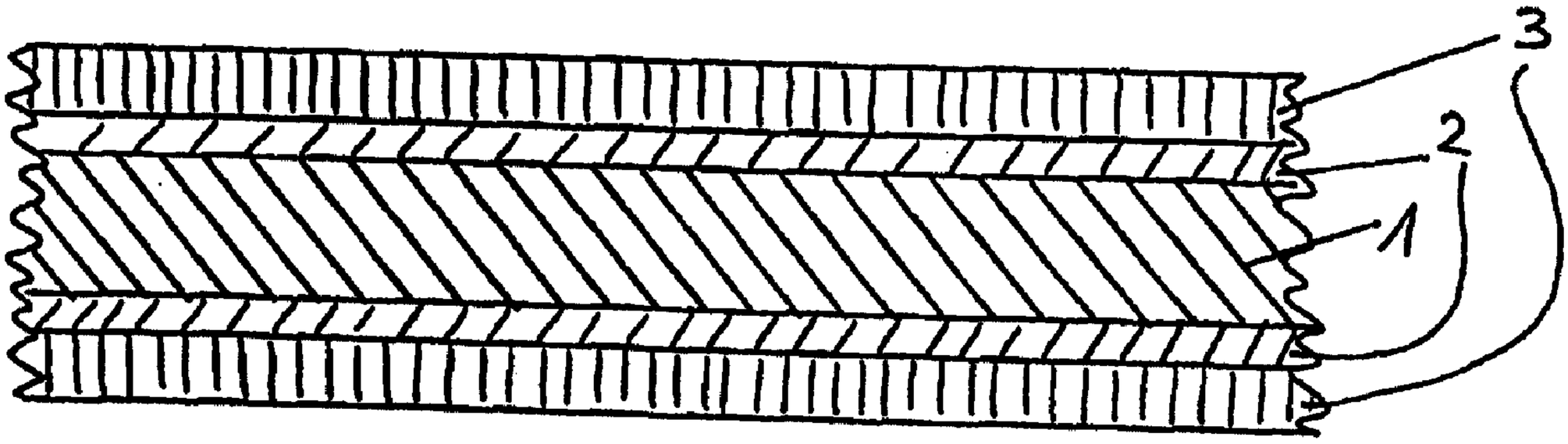
(54) Titre : MATERIAU COMPOSITE METALLIQUE ET SON PROCEDE DE FABRICATION
(54) Title: METALLIC COMPOSITE MATERIAL AND METHOD FOR THE PRODUCTION THEREOF



(57) Abrégé/Abstract:
The invention relates to a metal composite material which can be deep-drawn and sterilized and to a method for the production thereof, wherein a metallic band (1) is coated with a modified plastic layer (2) based on modified polypropylene by means of extrusion and, in addition, is optionally coated with a plastic layer (3) based on polypropylene by means of coextrusion. Afterwards, the resulting metallic composite material is heated to a temperature above the melting point of the modified plastic layer for a duration of 1 to 10 seconds.

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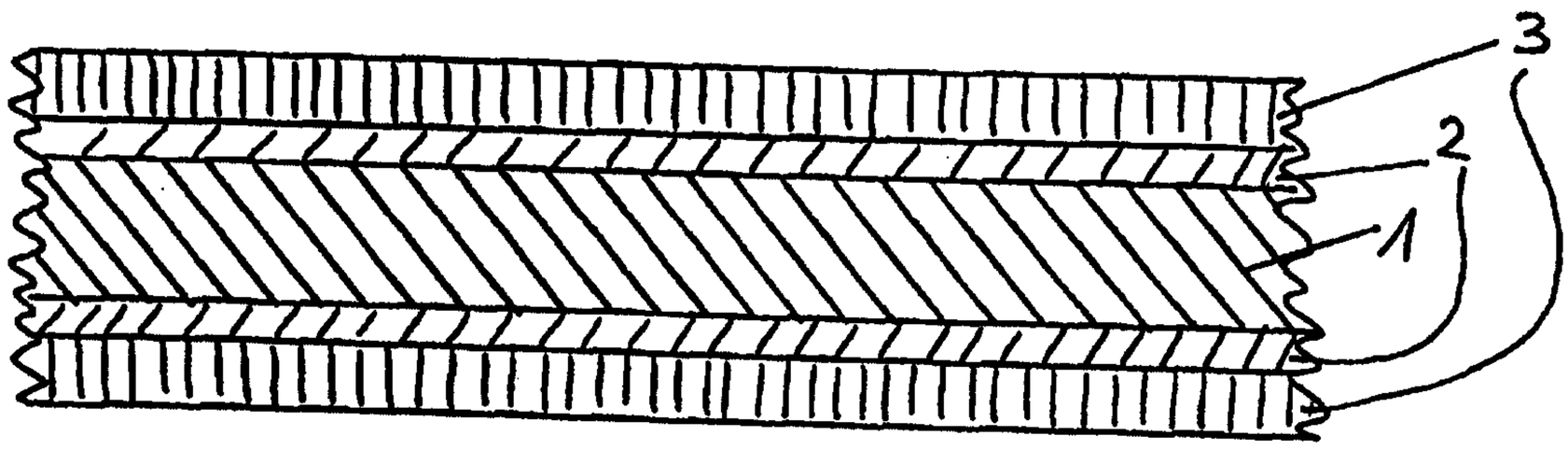
(54) Title: METALLIC COMPOSITE MATERIAL AND METHOD FOR THE PRODUCTION THEREOF

(54) Bezeichnung: METALLVERBUNDMATERIAL UND VERFAHREN ZU DESSEN HERSTELLUNG



(57) Abstract

The invention relates to a metal composite material which can be deep–drawn and sterilized and to a method for the production thereof, wherein a metallic band (1) is coated with a modified plastic layer (2) based on modified polypropylene by means of extrusion and, in addition, is optionally coated with a plastic layer (3) based on polypropylene by means of coextrusion. Afterwards, the resulting metallic composite material is heated to a temperature above the melting point of the modified plastic layer for a duration of 1 to 10 seconds.

(57) Zusammenfassung

Die vorliegende Erfindung betrifft ein tiefzieh– und sterilisierbares Metallverbundmaterial und ein Verfahren zu dessen Herstellung, worin ein Metallband (1) mit einer modifizierten Kunststoffschicht (2) auf Basis von modifiziertem Polypropylen durch Extrusion und gegebenenfalls zusätzlich mit einer Kunststoffschicht (3) auf Polypropylenbasis durch Coextrusion beschichtet wird und das resultierende Metallverbundmaterial anschließend auf eine Temperatur oberhalb des Schmelzpunktes der modifizierten Kunststoffschicht für eine Dauer von 1 bis 10 Sekunden erwärmt wird.

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Metallic Composite Material and a Method for the Production Thereof

The present invention relates to a metallic composite material comprising a metallic band (strip) and plastic layers applied thereon by extrusion and co-extrusion, respectively, as well as a method for the production thereof.

It is known to use metallic composite materials comprising metallic band, film or sheet and plastic layers applied on one side or both sides thereof for the production of hollow bodies, e.g. containers, by a deep-drawing or ironing method.

GB-A-2 003 415 discloses a method of deep-drawing and ironing thin-walled, deep containers of a composite material which consists of a sheet metal, e.g. aluminium, which at least on one side is laminated with a plastic layer on an adhesive resin layer. This is to prevent that while processed into containers the plastic layer is destroyed and the sheet metal is exposed.

EP-A-0 407 313 describes a method of producing a multi-layer material which can be used for the production of containers deeper than those described in GB-A-2 003 415 by deep-drawing or ironing. The multi-layer material comprises a surface-treated substrate of aluminium alloy, which is coated with a plastic material on one side and with a varnish layer on its other side. In order to be able to produce the hollow bodies with a greater height/diameter ratio without destroying the coating, the varnish layer additionally contains a solid, particulate lubricant which is harder than the varnish itself but softer than the tool used for ironing.

DE-A-195 29 583 and EP-B-0 690 785 disclose methods of coating metal webs or sheets by laminating a plastic sheet onto the metal web and heating it together with the metal web in a subsequent step to improve adhesion, so that the plastic sheet becomes plastically deformable.

Hollow bodies of deep-drawn metallic composite materials for use as containers can be sterilized after filling by heating them to temperatures of about 120-135°C for about 30-34 minutes. In contrast to the conventional composite materials produced by laminating and coating, respectively, the adhesion of the plastic layers to the metal, in particular to non-

pretreated metal, is not sufficient when using an extrusion coating – even if employing additional adhesives – to render the resulting composite material both deep-drawable and resistant to serilization.

Therefore, one problem of the present invention consists in providing a method for the production of a metallic composite material by extrusion coating, the resulting metallic composite material being able to be deep-drawn and sterilized without separation of the composite occurring.

It has been found surprisingly that this problem can be solved by a method in which a metallic band is coated by extrusion on one side or both sides with a modified plastic layer on the basis of modified polypropylene and the resulting metallic composite material is then heated for a period of 1 to 10 seconds, more preferably 1 to 3 seconds, and most preferably 1 to 2 seconds, to a temperature above the melting point of the modified plastic layer.

The improved adhesion between metallic band and coating during the use of the combination of extrusion coating and heat treatment according to the invention, is *inter alia* surprising because in the extrusion stage the extruded material is applied in its molten state onto the substrate. Therefore, improvement of adhesion to the substrate by a subsequent heat treatment in which the coating is again converted into its molten state was not expected on the basis of the prior art.

The metallic band can optionally be heated prior to the extrusion coating, but preferably not above 100°C, in particular not above the melting point of the material to be extruded. However, the extrusion coating is preferably applied to a metallic band with approximately ambient temperature, e.g. room temperature. In this way, the extruded material temporarily changes into its solid state after the coating and before the subsequent heat treatment step. The heating in the heat treatment step can be carried out by conventional methods, e.g. using hot air, infrared radiation or by inductive heating of the metallic band, the composite material including the modified plastic layer molten in this step failing to contact the rollers (e.g. by what is called a suspension drier in which the band is guided on an air cushion).

The cooling and the cooling rate after the heat treatment step are not subject to special restrictions. In particular, they can be forced by a special apparatus so as to achieve rapid cooling within the range of 100 to 200°C/s or more. Cooling is preferably effected by the ambient atmosphere alone without another apparatus being required, and cooling rates of

less than 100°C/s, e.g. less than 50°C/s, less than 30°C/s and less than 10°C/s generally suffice to achieve the effects of the method according to the invention.

The modified plastic layers have, independent of one another, preferably a weight per unit area of 3 to 40 g/m^2, more preferably one of 7 to 10 g/m^2. The modified plastic layers consist preferably of a maleic acid anhydride-modified polypropylene. In this case, the temperature in the heat treatment step is about 180°C, depending on the modification degree of the polypropylene.

The thickness of the metallic band is preferably 40 to 200 µm, more preferably 70 to 150 µm, and most preferably 90 µm. The metallic band may be surface-treated, e.g. by chromating. However, this is not absolutely required for a good adhesion of the modified plastic layer to the metallic band, and for reasons of costs it is preferred to use a metallic band which is not surface-treated. The metallic band also consists preferably of aluminium or aluminium alloy.

In a preferred embodiment, the metallic band is coated in the coating step additionally on one side or both sides with a polypropylene-based plastic layer by means of co-extrusion. In this embodiment, the modified plastic layer serves as a coupling agent between the metallic band and the plastic layer, and the weight per unit area of the modified plastic layers amounts, independent of one another, in this case preferably to 3 to 10 g/m^2, more preferably to 5 to 7 g/m^2.

In another preferred embodiment, the weight per unit area of the plastic layers amounts, independent of one another, to 3 to 40 g/m^2, and more preferably to 7 to 10 g/m^2. The plastic layers consist preferably of polypropylene or polypropylene copolymer, e.g. polypropylene/polyethylene copolymer, or polypropylene/polyethylene mixtures. An example is a mixture of polypropylene having 5 to 30 % by weight LDPE. In addition, the plastic layers can contain, independent of one another, one or several antiseize agents or lubricants, e.g. oleic acid amide or erucic acid amide, which enable deformation of the metallic composite material by deep-drawing without further lubrication of the material or the tools. If desired, one of the plastic layers can be made peelable.

The plastic layers and modified plastic layers can optionally be dyed, e.g. using dyes or pigments, it being particularly preferred when using a combination of modified plastic layer and plastic layer to dye immediately both the plastic layer and the modified plastic layer, one lying on top of the other. The advantage of this is that variations in the layer thickness of the individual plastic layer and modified plastic layer, respectively, do not change the shade as long as the entire layer thickness remains constant. Furthermore,

irregularities of color and striations or streak formations are compensated for, which may occur because of the different solubility and/or miscibility of the colors or pigments when using copolymers and compounds from various polypropylene kinds and polypropylene/polyethylene mixtures. Due to the good adhesive properties of the coating to the metallic band, the metallic composite material which can be produced by the method according to the invention can be used for the production of sterilizable hollow bodies, in particular containers.

Figure 1 shows a section through a preferred embodiment of the metallic composite material which can be produced by the method according to the invention. The metallic composite material comprises a metallic band 1 and the, applied by co-extrusion, modified plastic layers 2 and plastic layers 3.

As compared to the known methods, the method according to the invention comprises – in addition to the excellent adhesive properties between metallic band and coating – the advantages that it only requires one operating cycle, i.e. extrusion and co-extrusion, respectively, and no use of solvents as called for in coating methods. Pretreatment of the surface of the metallic band, e.g. by chromating as in the case of baked strips, is not necessary either. This results in markedly reduced production costs accompanied by equal or improved adhesive properties between the individual layers of the metallic composite material. Finally, it is possible to produce an easily recyclable metallic composite material from only two components, e.g. aluminium and modified polypropylene.

The present invention therefore provides a method for the production of a deep-drawable and sterilizable metallic composite material, comprising: (a) coating of a metallic strip on one side or both sides with a modified plastic layer based on modified polypropylene by extrusion, wherein the extrusion coating takes place on a metal strip of room temperature, such that the plastics layer passes temporarily into the solid state; and (b) heating of the resulting metallic composite material to a temperature above the melting point of the modified plastic layer for a period from 1 to 10 seconds in order to convert the plastics layer again into the melted state.

1. A method for the production of a deep-drawable and sterilizable metallic composite material, comprising:

(a) coating of a metallic strip on one side or both sides with a modified plastic layer based on modified polypropylene by extrusion, wherein the extrusion coating takes place on a metal strip of room temperature, such that the plastics layer passes temporarily into the solid state; and

(b) heating of the resulting metallic composite material to a temperature above the melting point of the modified plastic layer for a period from 1 to 10 seconds in order to convert the plastics layer again into the melted state.

2. The method according to claim 1, wherein, independently of one another, the modified plastic layers have a weight per unit area of 3 to 40 g/m^2.

3. The method according to claim 1 or 2, wherein the modified plastic layers consist of maleic anhydride-modified polypropylene.

4. The method according to any one of claims 1 to 3, wherein the metallic band has a thickness of 40 to 200 μm.

5. The method according to any one of claims 1 to 4, wherein a metallic band which is not surface-treated is used as the metallic strip.

6. The method according to any one of claims 1 to 5, wherein the metallic strip is coated additionally in step (a) on one or both sides with a plastic layer based on polypropylene by coextrusion, and wherein the modified plastic layer serves as a bonding agent.

7. The method according to claim 6, wherein, independently of one another, the modified plastic layers have a weight per unit area of 3 to 10 g/m^2.

8. The method according to claim 6 or 7, wherein, independently of one another, the plastic layers have a weight per unit area of 3 to 40 g/m^2.

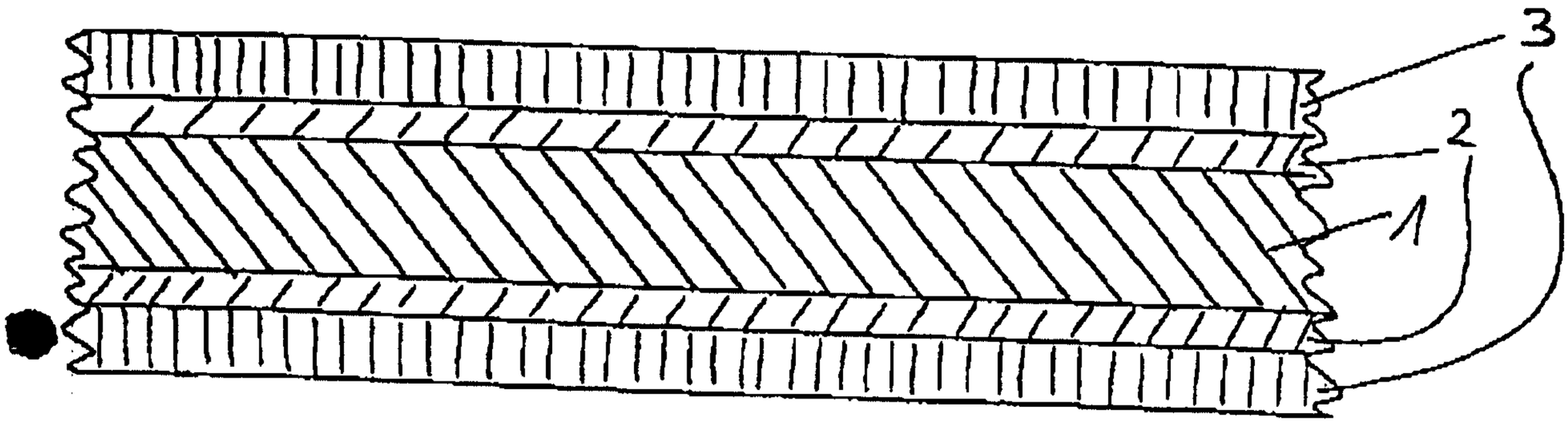
9. The method according to any one of claims 6 to 8, wherein, independently of one another, the plastic layers comprise polypropylene or polypropylene copolymer.

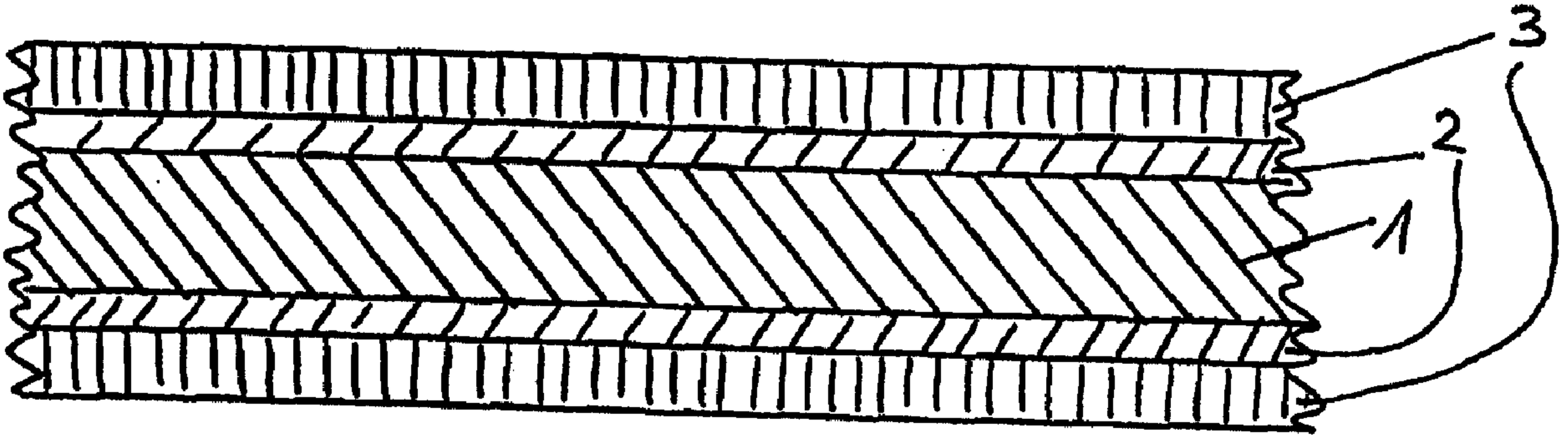
10. The method according to any one of claims 6 to 9, wherein the modified plastic layers contain additionally one or slip agents or lubricants.

11. The method according to any one of claims 6 to 10, wherein the modified plastic layers and the plastic layers on one or both sides of the metallic strip are in each case colored the same color.

12. Use of the metallic composite material producible according to any one of claims 1 to 11 for the production of hollow bodies by a deep-draw or ironing method.

Fig. 1

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