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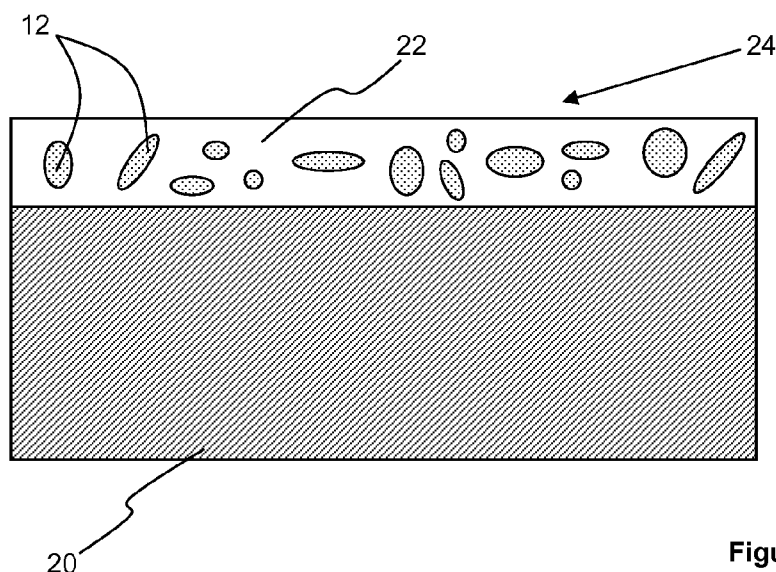


Figure 2

(57) Abstract: A method of applying a metallic coating (24) to a surface of a sheet material (20) comprises forming a coating dispersion, the coating dispersion comprising coating particles (10) dispersed in a solvent. The coating particles (10) each comprise a polymeric material (14) and a metallic material (12). A sheet material (20) having a first surface is provided and the coating dispersion is applied to the first surface of the sheet material (20). The coating dispersion is dried to form a coating (24) on the first surface of the sheet material (20), the coating (24) comprising the metallic material (12) dispersed in a layer (22) of the polymeric material (14). The coating dispersion is heated to a temperature of at least 50 degrees Celsius to melt the polymeric material.



METHOD OF FORMING A METALLIC COATING

The present invention relates to a method of applying a metallic coating to a sheet material and to printed articles comprising such a coating. The present invention also relates to the use of a dispersion of coating particles to form a metallic coating on a substrate. The invention finds particular application as a method of forming a metallic coating on a paper or cardboard substrate, such as a container for consumer goods.

Consumer goods may be packaged in many different types of containers formed from a variety of materials and in some cases it may be desirable to provide such containers with a metallic appearance. However, it is often impractical or not cost effective to form containers from a metal. Therefore, containers for consumer goods are typically formed from sheet materials that are more readily available and easier to process on high speed packaging machinery, where the sheet materials receive a surface treatment to provide a metallic appearance. Typical sheet materials include for example paper, cardboard, plastic.

Existing surface treatments for providing a metallic appearance on a non-metallic substrate include hot foil stamping or lamination for example with a metalised PET film. However, such foils and films may become wrinkled upon application to the substrate. Furthermore, foils and films must normally be applied in an offline process which may require a complex registration between the foil or film and the sheet material. This need for registration may result in expensive waste where the registration is insufficient or only a small amount of the metal material is transferred to the sheet material. Additionally, metal foils and films may fail to provide satisfactory visual integration with non-metallic printed portions of any artwork or design printed onto surrounding areas of the substrate.

International patent application WO-A-2012/099698 describes an alternative metallic surface treatment comprising an energy-cured coating, for example using ultra violet light. However, the implementation of this process can be expensive as it requires at least a dedicated curing station and complex photo-initiators in the coating.

Therefore, it would be desirable to provide a novel method of applying a metallic coating to a sheet material that is simple, cost effective and can be integrated easily into existing production processes.

The present invention provides a method of applying a metallic coating to a sheet material, the method comprising forming a coating dispersion, the coating dispersion comprising coating particles dispersed in a solvent. The coating particles each comprise a polymeric material and a metallic material. A sheet material having a first surface is provided and the coating dispersion is applied to the first surface of the sheet material. The coating dispersion is dried to form a coating on the first surface of the sheet material, the coating comprising the

metallic material dispersed in a layer of the polymeric material. The coating dispersion is heated to a temperature of at least about 50 degrees Celsius to melt the polymeric material. The drying and heating steps may be performed separately, or they may be performed as a single step.

5 As used herein, the term "metallic material" is a material that comprises metal particles, metal flakes, or both. A metallic material may comprise between about 10 percent and 100 percent of metal by weight, preferably between about 50 percent and about 98 percent metal by weight.

10 Advantageously, the use of a dispersion comprising coating particles formed from a polymeric material and a metallic material permits the application of the coating to the substrate in a single step, without requiring the separate application of polymeric base and top coats and an intermediate metallic coat. Furthermore, the dispersion can be used with existing coating methods, such as printing, without the need for significant modification to relevant production machinery. In particular, the method according to the present invention can be implemented as
15 an inline process so that the coating dispersion can be applied at subsequent stages of the same printing press as printed inks, for example. This may greatly simplify the registration step between the applied metallic coating and preceding or subsequent applications of ink. Registration between printing stations in printing presses is well established and generally significantly more precise and easier to achieve than overprinting a metallic surface area that
20 has been created in an offline process, such as for example hot foil stamping. Using a coating dispersion also eliminates the need for a separate curing station. Further complex and expensive photo initiators required by the curable coatings described in the prior art are not required to create the metallic appearance.

25 Heating the coating dispersion to melt the polymeric material after the coating dispersion has been applied to the sheet material can melt the coating particles to form a continuous polymeric film comprising the metallic material dispersed in the polymeric film, which may advantageously provide a more uniform coating.

30 The step of forming the coating dispersion preferably comprises dispersing the metallic material, at least one monomer and a cross-linking agent in a solvent to form a colloidal system. The colloidal system is heated to initiate polymerisation of the at least one monomer, wherein the polymerisation forms the coating particles each comprising the polymeric material and the metallic material. Preferably, the solvent comprises water, the method further comprising a step of mixing the colloidal system with a non-polar solvent prior to heating the colloidal system. Mixing the colloidal system comprising water with the non-polar solvent forms an emulsion
35 which is heated to form the coating particles dispersed within a solvent.

This method of forming the coating dispersion can form coating particles having dimensions in the micrometre range, such as between about 0.1 micrometre and about 10 micrometres. Forming coating particles having a size within this range advantageously results in a smoother final coating after the dispersion has been applied to the substrate and dried.

5 Preferably, the step of heating the colloidal system comprises heating the colloidal system to a temperature of between about 35 degrees Celsius to about 50 degrees Celsius, more preferably between about 40 degrees Celsius and about 45 degrees Celsius. Preferably, the heating step heats the colloidal system to a temperature that is below the melting point of the polymer formed from polymerisation of the at least one monomer.

10 The non-polar solvent may comprise one or more of a carbohydrate with a chain length between 6 and 12, like for example hexane, cyclohexane or decane.

In any of the embodiments described above, each coating particle preferably comprises the metallic material contained within the polymeric material. Advantageously, containing the metallic material within the polymeric material ensures that a majority of the metallic material is
15 dispersed within the layer of polymeric material after the coating dispersion has been dried. This may reduce the risk of the metallic material becoming dislodged from the coating.

The heating step comprises heating the coating dispersion to a temperature of at least about 50 degrees Celsius. In any of the embodiments described above, the heating step preferably comprises heating the coating dispersion to a temperature of less than about 200
20 degrees Celsius. More preferably, the heating step comprises heating the coating dispersion to a temperature of between about 50 degrees Celsius and about 150 degrees Celsius, more preferably between about 60 degrees Celsius and about 120 degrees Celsius, more preferably between about 70 degrees Celsius and about 100 degrees Celsius, most preferably between about 80 degrees Celsius and about 90 degrees Celsius.

25 In any of the embodiments described above, the drying step preferably comprises heating the coating dispersion to a temperature of at least about 50 degrees Celsius. Additionally, or alternatively, the drying step may comprise heating the coating dispersion to a temperature of less than about 200 degrees Celsius. More preferably, the drying step comprises heating the coating dispersion to a temperature of between about 50 degrees Celsius and about 150
30 degrees Celsius, more preferably between about 60 degrees Celsius and about 120 degrees Celsius, more preferably between about 70 degrees Celsius and about 100 degrees Celsius, most preferably between about 80 degrees Celsius and about 90 degrees Celsius.

Preferably, the drying step comprises heating the coating dispersion to a temperature at least above the softening point of the polymeric material. This advantageously may improve the
35 bonding of the coating particles together to form the coating. Preferably, the drying step comprises heating the coating dispersion to a temperature above the melting point of the

polymeric material so that the coating particles melt and form a continuous polymeric film comprising the metallic material dispersed in the polymeric film. In such embodiments, the steps of drying the coating dispersion and heating the coating dispersion to melt the polymeric material may comprise a single step of heating the coating dispersion to a temperature of at least about 50 degrees Celsius to dry the coating dispersion and to melt the polymeric material. Preferably, the single step of heating the coating dispersion to dry the coating dispersion and to melt the polymeric material comprises heating the coating dispersion to a temperature of less than about 200 degrees Celsius. The single step of heating the coating dispersion to dry the coating dispersion and to melt the polymeric material may comprise heating the coating dispersion to a temperature of between about 50 degrees Celsius and about 150 degrees Celsius, more preferably between about 60 degrees Celsius and about 120 degrees Celsius, more preferably between about 70 degrees Celsius and about 100 degrees Celsius, most preferably between about 80 degrees Celsius and about 90 degrees Celsius.

The polymeric material preferably comprises at least one of acrylic, nylon, polyethylene, polypropylene, polystyrene, polyvinyl chloride, Teflon®, or combinations thereof.

The melting point of the polymeric material is preferably between about 50 degrees Celsius and about 150 degrees Celsius, more preferably between about 60 degrees Celsius and about 120 degrees Celsius, more preferably between about 70 degrees Celsius and about 100 degrees Celsius, most preferably between about 80 degrees Celsius and about 90 degrees Celsius.

The softening point of the polymeric material is preferably at least about 60 degrees Celsius, more preferably at least about 70 degrees Celsius, most preferably at least about 80 degrees Celsius.

The applying step preferably comprises printing the dispersion onto the first surface of the sheet material using rotogravure printing or flexographic printing. Advantageously, both of these printing methods permit the application of large volumes of the coating dispersion in a single pass when compared to other printing methods.

The metallic material may comprise metal particles, metal flakes or both. Preferably, the metallic material comprises aluminium. Each coated particle preferably comprising the metallic material in an amount of between about 10 percent to about 75 percent by weight of the particle.

The sheet material may include any suitable material, such as paper, cardboard or plastic. In some embodiments, the sheet material includes a blank which may be folded to form a container for consumer goods. For example, the sheet material may be a blank that, when folded, forms a container for elongate smoking articles, such as a hinged lid box, as for example a Flip-Top® box.

The present invention also extends to substrates having a metallic coating applied thereon in accordance with any of the embodiments of the method described above.

The coating preferably has a static coefficient of friction of between about 0.2 and about 0.6, more preferably between about 0.35 and about 0.45, most preferably about 0.4, when measured in accordance with the ISO 8295 coating-to-coating test method.

The coating preferably has a dynamic coefficient of friction of between about 0.1 and about 0.6, more preferably between about 0.2 and about 0.4, most preferably about 0.25, when measured in accordance with the ISO 8295 coating-to-coating test method.

The substrate and the coating may form a printed article, and therefore the present invention also provides a printed article comprising a sheet material and a coating on a surface of the sheet material, the coating comprising a single print layer, wherein the single print layer comprises a metallic material dispersed in a polymeric material.

The term "single print layer" is used herein to mean a layer of a coating material that is deposited on a substrate in a single printing pass. In some embodiments of the invention, the single print layer covers the entire surface. In other embodiments of the invention, the single print layer covers selected areas of the surface. The skilled person can determine whether a coating comprises one or more print layers using suitable microscopic analysis of the coating.

The printed article may include any of the preferred features described above with respect to the method of applying the coating to the substrate. For example, the layer of polymeric material may comprise a plurality of polymeric particles each containing the metallic material. The individual polymeric particles will be observable in the dried coating if the polymeric material has been heated to a temperature above the softening point but below the melting point of the polymeric material during the drying step.

The present invention also extends to the use of a dispersion to form a metallic coating on a substrate, the dispersion comprising coating particles dispersed in a solvent, each coating particle comprising a polymeric material and a metallic material.

The invention will now be further described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 shows a coating particle used within a coating dispersion in accordance with the present invention; and

Figure 2 shows a metallic coating formed in accordance with the present invention.

Figure 1 shows a coating particle 10 that is used within a coating dispersion in accordance with the present invention. The coating particle 10 comprises one or a number of aluminium flakes 12 contained within a polyolefin capsule 14. A plurality of coating particles 10 is dispersed within water to form the coating dispersion. The coating dispersion is then applied to a sheet material and dried to form a metallic coating.

Figure 2 shows a sheet material 20 comprising a sheet of cardboard to which a coating dispersion has been applied. The coating dispersion is dried by heating the coating dispersion to a temperature above the melting point of the polyolefin that forms the polyolefin capsule 14 of each coating particle 10. The heating step therefore evaporates the water solvent and melts the polyolefin capsules 14 so that the polyolefin forms a continuous polyolefin layer 22 on the sheet material 20. The aluminium flakes 12 from the coating particles 10 are dispersed within the polyolefin layer 22 so that the combination of the polyolefin layer 22 and the aluminium flakes 12 forms a metallic coating 24 on the sheet material.

Claims

1. A method of applying a metallic coating to a sheet material, the method comprising:
forming a coating dispersion comprising coating particles dispersed in a solvent, the
5 coating particles each comprising a polymeric material and a metallic material;
providing a sheet material having a first surface;
applying the coating dispersion to the first surface of the sheet material;
drying the coating dispersion to form a coating on the first surface of the sheet material,
the coating comprising the metallic material dispersed in a layer of the polymeric material; and
10 heating the coating dispersion to a temperature of at least 50 degrees Celsius to melt
the polymeric material.
2. A method according to claim 1, wherein the step of forming the coating dispersion
comprises:
15 dispersing the metallic material, at least one monomer and a cross-linking agent in a
solvent to form a colloidal system; and
heating the colloidal system to initiate polymerisation of the at least one monomer,
wherein the polymerisation forms the coating particles each comprising the polymeric material
and the metallic material.
- 20 3. A method according to claim 2, wherein the solvent comprises water, the method further
comprising a step of mixing the colloidal system with a non-polar solvent prior to heating the
colloidal system to initiate polymerisation of the monomer.
- 25 4. A method according to claim 3, wherein the non-polar solvent comprises at least one or
a carbohydrate with a chain length between 6 and 12, like for example hexane, cyclohexane or
decane.
5. A method according to any preceding claim, wherein each coating particle comprises the
30 metallic material contained within the polymeric material.
6. A method according to any preceding claim, wherein the drying step comprises heating
the coating dispersion to a temperature of between 50 degrees Celsius and 150 degrees
Celsius.

7. A method according to any preceding claim, wherein the polymeric material comprises at least one of acrylic, nylon, polyethylene, polypropylene, polystyrene, polyvinyl chloride, Teflon®, and combinations thereof.
- 5 8. A method according to any preceding claim, wherein the polymeric material has a melting point of between 50 degrees Celsius and 150 degrees Celsius.
9. A method according to any preceding claim, wherein the applying step comprises printing the dispersion onto the first surface of the sheet material using rotogravure printing or
10 flexographic printing.
10. A method according to any preceding claim, wherein the metallic material comprises metal particles, metal flakes or both.
- 15 11. A method according to any preceding claim, wherein the metallic material comprises aluminium.
12. A container for consumer goods, formed from a sheet material, wherein the sheet material comprises a metallic coating, wherein the metallic coating is applied using a method
20 according to claims 1 to 11.
13. A printed article comprising:
a sheet material; and
a coating on a surface of the sheet material, the coating comprising a single print layer,
25 wherein the single print layer comprises a metallic material dispersed in a polymeric material.
14. A printed article according to claim 13, wherein the layer of polymeric material comprises a plurality of polymeric particles each containing the metallic material.
- 30 15. Use of a dispersion to form a metallic coating on a substrate, the dispersion comprising coating particles dispersed in a solvent, each coating particle comprising a polymeric material and a metallic material.

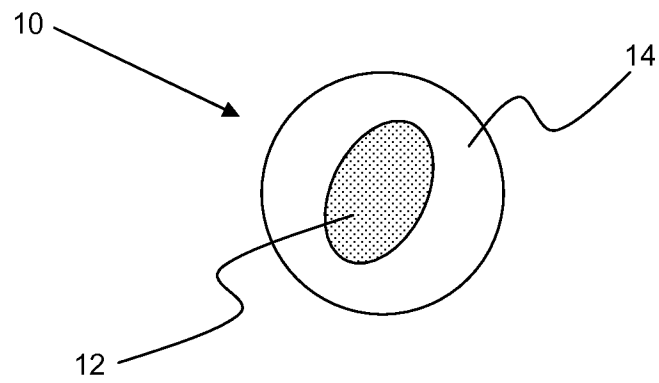


Figure 1

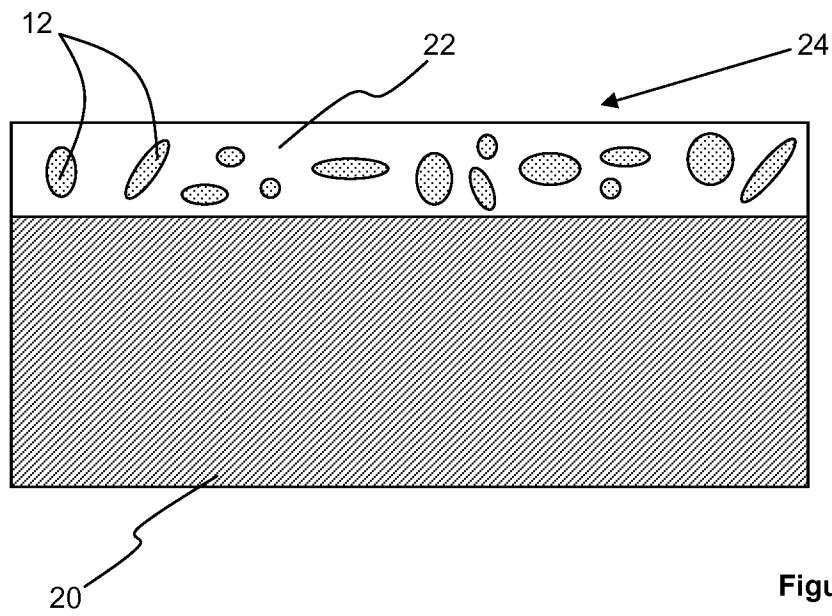


Figure 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/079316

A. CLASSIFICATION OF SUBJECT MATTER		
INV.	D21H25/06 B65D65/38	D21H27/10 D21H13/36 D21H15/02
	D21H15/08 D21H17/34	D21H17/35 D21H17/54 D21H17/63
	D21H17/00 D21H19/58	D21H19/64 D21H19/66 D21H21/50
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) D21H B65D C08K		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	examples 1,4-6 claims 1-22	1-14
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Y	page 3, line 2 - line 3	12-14
A	claims 1,3	1-11,15
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Y	claim 1	12-14
A	column 6, line 10 - line 22	1-11,15
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☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 12 February 2015		Date of mailing of the international search report 19/02/2015
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Ponsaud, Philippe

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Information on patent family members

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