(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
2 August 2012 (02.08.2012)

WIPO | PCT

(10) International Publication Number
WO 2012/102565 A2

(51) International Patent Classification: Not classified

(21) International Application Number:
PCT/KR2012/000624

(22) International Filing Date:
27 January 2012 (27.01.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10-2011-0008483 27 January 2011 (27.01.2011) KR

(71) Applicant *(for all designated States except US)*: **LG INNOTEK CO., LTD.** [KR/KR]; Seoul Square, 541, Namdaemunno 5-Ga, Jung-Gu, Seoul 100-714 (KR).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **LEE, Dong Youl** [KR/KR]; Seoul Square, 541, Namdaemunno 5-Ga, Jung-Gu, Seoul 100-714 (KR). **CHAI, Kyoung Hoon** [KR/KR]; Seoul Square, 541, Namdaemunno 5-Ga, Jung-Gu, Seoul 100-714 (KR). **YOU, Young Sun** [KR/KR]; Seoul Square, 541, Namdaemunno 5-Ga, Jung-Gu, Seoul 100-714 (KR). **LEE, Yong Jin** [KR/KR]; Seoul Square, 541, Namdaemunno 5-Ga, Jung-Gu, Seoul 100-714 (KR). **NOH, Young Jin** [KR/KR]; Seoul Square, 541, Namdaemunno 5-Ga, Jung-Gu, Seoul 100-714 (KR). **LEE, Sun-Young** [KR/KR]; Seoul Square, 541, Namdaemunno 5-Ga, Jung-Gu, Seoul 100-714 (KR).

(74) Agent: **SEO, Kyo Jun**; 9th Fl., Hyun Juk Bldg., 832-41, Yeoksam-dong, Gangnam-gu, Seoul 135-080 (KR).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

WO 2012/102565 A2

(54) Title: GRAVURE ROLL AND MANUFACTURING THE SAME

(57) Abstract: A gravure roll according to the embodiment includes a base roll; a copper plating layer provided on the base roll and formed on a surface thereof with a plurality of grooves; and a nickel-phosphorus (Ni-P) alloy layer on the copper plating layer.

Description

Title of Invention: GRAVURE ROLL AND MANUFACTURING THE SAME

Technical Field

[1] The disclosure relates to a gravure roll and a method of manufacturing the same.

Background Art

[2] Technologies for direct pattern printing apparatuses have been actively developed to manufacture electric and electronic appliances, such as displays and mobile devices. In a printing apparatus, a paste is filled in a pattern groove of a gravure roll by a doctor blade and then the paste is transferred onto a substrate to print a predetermined pattern on the substrate.

[3] A chrome layer serving as a surface enhanced coating layer is formed on the gravure roll used in the printing apparatus. However, the chrome layer has toxicity, causing the environmental pollution.

Disclosure of Invention

Technical Problem

[4] The embodiment provides a gravure roll having sufficient strength, substituting for a chrome layer, without causing the environmental pollution and a method of manufacturing the same.

Solution to Problem

[5] A gravure roll according to the embodiment includes a base roll; a copper plating layer provided on the base roll and formed on a surface thereof with a plurality of grooves; and a nickel-phosphorus (Ni-P) alloy layer on the copper plating layer.

Advantageous Effects of Invention

[6] According to the gravure roll of the embodiment, since the Ni-P alloy layer is directly formed instead of a chrome layer, the gravure roll has no toxicity, so the environmental pollution can be prevented. In addition, an additional metal layer is not necessary, so the thickness of the gravure roll can be reduced, the manufacturing process can be simplified and the manufacturing cost can be reduced.

[7] According to the method of manufacturing the gravure roll of the embodiment, the gravure roll having the above structure can be provided.

Brief Description of Drawings

[8] FIG. 1 is a schematic perspective view showing a printing apparatus;

[9] FIG. 2 is a sectional view showing a gravure roll according to the first embodiment;

[10] FIG. 3 is a sectional view showing a gravure roll according to the second em-

bodiment;

[11] FIG. 4 is an enlarged sectional view of an "A" portion shown in FIG. 3; and

[12] FIGS. 5 to 9 are sectional views showing the manufacturing steps for a gravure roll according to the embodiment.

Mode for the Invention

[13] In the description of the embodiments, it will be understood that, when a layer (film), a region, a pattern or a structure is referred to as being "on" or "under" another layer (film), another region, another pad or another pattern, it can be "directly" or "indirectly" on the other layer (film), region, pad or pattern, or one or more intervening layers may also be present. Such a position of the layer has been described with reference to the drawings.

[14] The thickness and size of each layer shown in the drawings may be exaggerated, omitted or schematically drawn for the purpose of convenience or clarity. In addition, the size of elements show in the drawings does not utterly reflect an actual size.

[15] Hereinafter, embodiments will be described in detail with reference to accompanying drawings.

[16] First, a printing apparatus will be described with reference to FIG. 1. FIG. 1 is a schematic perspective view showing the printing apparatus.

[17] Referring to FIG. 1, the printing apparatus includes a gravure roll 100 having a groove 500 for receiving a paste 110 and a doctor blade 200 adjacent to the gravure roll 100 to fill the paste 110 in the groove 500. In addition, the printing apparatus may include a blanket roll 300 which receives the paste 110 from the groove 500 of the gravure roll 100 and transfers the paste 110 onto a substrate 400.

[18] In the above printing apparatus, the doctor blade 200 fills the paste 110 in the gravure roll 100, the paste 110 is moved to the blanket roll 300 and then the paste 110 is transferred onto the substrate 400 to form a pattern 410.

[19] Hereinafter, the gravure roll 100 of the printing apparatus will be described in detail with reference to FIG. 2.

[20] FIG. 2 is a sectional view showing a gravure roll according to the first embodiment.

[21] Referring to FIG. 2, the gravure roll 101 according to the first embodiment includes a base roll 10, a copper plating layer 20 formed on the base roll 10 and having grooves 20a, and a Ni-P alloy layer 30 formed on the copper plating layer 20.

[22] The base roll 10 may have a cylindrical shape in such a manner that the base roll 10 can rotate, but the embodiment is not limited thereto. For instance, the base roll 10 may have a plate shape. In this case, the base roll 100 may not rotate. The base roll 10 can be formed by using various materials having durability against repetition of the printing processes. For instance, the base roll 10 can be formed by using a metal.

[23] The copper plating layer 20 can be formed on the base roll 10 by plating copper on the base roll 10. The copper plating layer 20 may enhance the hardness of the gravure roll 101 so that the gravure roll 101 may satisfy the hardness required for the gravure printing process. In addition, a printing pattern can be formed by forming a gravure pattern in the copper plating layer 20.

[24] A plurality of grooves 20a are formed on a surface of the copper plating layer 20. As described above, the paste 110 (see, FIG. 1) is filled in the grooves 20a later to performed the printing process. The copper plating layer 20 may have the thickness in the range of about 50㎛ to about 200㎛.

[25] Then, the Ni-P alloy layer 30 is formed on the copper plating layer 20.

[26] The Ni-P alloy layer 30 includes Ni and P. The Ni-P alloy layer 30 has the hardness of about 700Hv or above with the superior corrosion-resistant and surface-glossing properties.

[27] In detail, the content of P in the Ni-P alloy layer 30 is about 10 wt% to about 20 wt%. If the content of P is less than 10 wt%, the Ni-P alloy layer 30 may not have the strength similar to that of the conventional chrome layer, so the Ni-P alloy layer 30 may not serve as a surface enhanced coating layer. In contrast, if the content of P exceeds 20 wt%, the plating efficiency as a function of time may be degraded.

[28] If the content of P is about 15 wt% or above, the Ni-P alloy represents the amorphous property and is chemically stable with high hardness. Due to the amorphous property, other medicines may not penetrate into the Ni-P alloy. In this regard, preferably, the content of P is in the range of 15 wt% to 20 wt%.

[29] However, the embodiment is not limited to the above. For instance, the Ni-P alloy layer 30 may include tungsten (W) in addition to Ni and P. In this case, the content of P is in the range of 10 wt% to 20 wt% and the content of W is in the range of 1 wt% to 20 wt%. If the Ni-P alloy layer 30 further include W, the wear-resistant and corrosion-resistant properties and the hardness can be more enhanced. However, if the content of W exceeds 20 wt%, the plating efficiency as a function of time may be degraded.

[30] The Ni-P alloy layer 30 is advantageous for the printing process. In detail, when the paste 110 is filled in the groove 20a of the gravure roll during the printing process, the doctor blade 200 (see, FIG. 1) may move while making contact with the surface of the gravure roll 101. As the contact frequency of the doctor blade 200 with respect to the gravure roll 101 is increased, the surface of the gravure roll 101 may be damaged so that the life span of the gravure roll 101 may be shortened. In this regard, the Ni-P alloy layer 30 having the high strength is provided to reinforce the surface of the gravure roll 101. In addition, the Ni-P alloy layer 30 may substitute for the chrome layer, which causes the environmental pollution, so that the environmental pollution can be prevented.

[31] In addition, since the Ni-P alloy layer 30 directly makes contact with the copper plating layer 20 without forming an additional metal layer or a carbonated metal gradient layer between the Ni-P alloy layer 30 and the copper plating layer 20, the thickness of the gravure roll 101 can be reduced. Further, the manufacturing steps and the manufacturing cost for the gravure roll 101 can be reduced.

[32] The Ni-P alloy layer 30 may have the thickness in the range of 1㎛ to 200㎛. If the thickness of the Ni-P alloy layer 30 is less than 1㎛, the Ni-P alloy layer 30 may not serve as the surface enhanced coating layer. In addition, if the thickness of the Ni-P alloy layer 30 exceeds 200㎛, the Ni-P alloy layer 30 may be delaminated due to the internal stress. Further, if the thickness of the Ni-P alloy layer 30 exceeds 200㎛, the depth and width required for the gravure roll 101 may be reduced, so the desired pattern may not be achieved when the printing process is performed by using the gravure roll 101.

[33] Hereinafter, a gravure roll according to the second embodiment will be described in detail with reference to FIGS. 3 and 4. For the purpose of clarity and simplicity, description about the elements and structures substantially similar to those of the first embodiment may be omitted and following description will be focused on the different parts.

[34] FIG. 3 is a sectional view showing the gravure roll according to the second embodiment, and FIG. 4 is an enlarged sectional view of an "A" portion shown in FIG. 3.

[35] Referring to FIGS. 3 and 4, in the gravure roll 102 according to the second embodiment, a concavo-convex part 20b is formed on the surface of the copper plating layer 20 provided on the base roll 10. The concavo-convex part 20b may enhance the contact strength between the copper plating layer 20 and the Ni-P alloy layer 30 directly making contact with the copper plating layer 20. In detail, friction may be increased between the copper plating layer 20 and the Ni-P alloy layer 30 due to the fine concavo-convex part, so that the Ni-P alloy layer 30 can securely make contact with the copper plating layer 20 without the additional metal layer. The surface roughness of the concavo-convex part 20b is in the range of 10nm to 100nm, preferably, 10nm to 45nm. If the surface roughness of the concavo-convex part 20b is less than 10nm, the adhesive strength between the copper plating layer 20 and the Ni-P alloy layer 30 may be lowered. If the surface roughness of the concavo-convex part 20b exceeds 100nm, undesired patterns may be formed during the printing process.

[36] Hereinafter, the method of manufacturing the gravure roll according to the embodiment will be described with reference to FIGS. 5 to 9.

[37] FIGS. 5 to 9 are sectional views showing the manufacturing steps for the gravure roll according to the embodiment.

[38] First, as shown in FIG. 5, the base roll 10 for the gravure roll is prepared.

[39] Then, as shown in FIG. 6, copper is plated on the base roll 10 to form the copper plating layer 20.

[40] As shown in FIG. 7, at least one groove 20a is formed on the copper plating layer. The groove 20a can be formed through various schemes generally known in the art, such as the etching scheme or the electronic engraving scheme. In detail, according to the etching scheme, the photoresist is coated and directly printed on a copper plate and then etched to form the groove 20a. According to the electronic engraving scheme, a diamond engraving needle is mechanically operated based on the digital signals to form the groove 20a on the surface of the copper plating layer 20.

[41] Then, as shown in FIG. 8, the concavo-convex part 20b is formed on the surface of the copper plating layer 20. The process for forming the concavo-convex part 20b can be omitted to provide the copper plating layer 20 without the concavo-convex part 20b such as the gravure roll 101 (see, FIG. 2) according to the first embodiment. The concavo-convex part 20b can be formed through the plasma etching scheme such that the concavo-convex part 20b may have the fine surface roughness. The plasma etching scheme may be chemically performed through the surface diffusion of radicals or physically performed by causing the ion bombardment using an electrode. The plasma etching scheme may be employed when the fine and precise etching is necessary.

[42] After that, as shown in FIG. 9, the Ni-P alloy layer 30 is formed on the copper plating layer 20. The Ni-P alloy layer 30 can be formed through the electroplating scheme or the electroless plating scheme.

[43] The electroplating scheme adopts the principle of the electrolysis. In order to plate the Ni-P alloy layer 30 according to the present embodiment, a phosphite-containing solution may be employed.

[44] The electroless plating scheme employs the chemical reaction without using electricity. That is, a reducing agent is included in a plating solution, so that the metal reduced by the reducing agent can be coated. In order to plate the Ni-P alloy layer 30 according to the present embodiment, hypophosphite may be employed.

[45] Any reference in this specification to "one embodiment," "an embodiment," "example embodiment," etc., means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the invention. The appearances of such phrases in various places in the specification are not necessarily all referring to the same embodiment. Further, when a particular feature, structure, or characteristic is described in connection with any embodiment, it is submitted that it is within the purview of one skilled in the art to effects such feature, structure, or characteristic in connection with other ones of the embodiments.

[46] Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modi-

fications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this disclosure. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

Claims

[Claim 1] A gravure roll comprising:
a base roll;
a copper plating layer provided on the base roll and formed on a surface thereof with a plurality of grooves; and
a nickel-phosphorus (Ni-P) alloy layer on the copper plating layer.

[Claim 2] The gravure roll of claim 1, wherein a content of the phosphorous is in a range of 10 wt% to 20 wt%.

[Claim 3] The gravure roll of claim 1, wherein a content of the phosphorous is in a range of 15 wt% to 20 wt%.

[Claim 4] The gravure roll of claim 1, wherein the Ni-P alloy layer includes tungsten (W).

[Claim 5] The gravure roll of claim 4, wherein a content of the tungsten is in a range of 1 wt% to 20 wt%.

[Claim 6] The gravure roll of claim 1, wherein the copper plating layer has a thickness in a range of 50㎛ to 200㎛.

[Claim 7] The gravure roll of claim 1, wherein the Ni-P alloy layer has a thickness in a range of 1㎛ to 200㎛.

[Claim 8] The gravure roll of claim 1, wherein the copper plating layer is formed on a surface thereof with a concavo-convex part.

[Claim 9] The gravure roll of claim 8, wherein the copper plating layer has a surface roughness in a range of 10nm to 100nm.

[Claim 10] The gravure roll of claim 8, wherein the copper plating layer has a surface roughness in a range of 10nm to 45nm.

[Claim 11] A method of manufacturing a gravure roll, the method comprising:
preparing a base roll;
forming a copper plating layer on the base roll;
forming at least one groove on the copper plating layer; and
forming a nickel-phosphorus (Ni-P) alloy layer on the copper plating layer.

[Claim 12] The method of claim 11, wherein the Ni-P alloy layer is formed through at least one of an electroplating and an electroless plating.

[Claim 13] The method of claim 11, further comprising forming a concavo-convex part on a surface of the copper plating layer after forming at least one groove on the copper plating layer and before forming the Ni-P alloy layer on the copper plating layer.

[Claim 14] The method of claim 13, wherein the concavo-convex part is formed

through a plasma etching.

[Claim 15] The method of claim 13, wherein, in the forming of the concavo-convex part, the copper plating layer has a surface roughness in a range of 10nm to 100nm.

[Claim 16] The method of claim 13, wherein, in the forming of the concavo-convex part, the copper plating layer has a surface roughness in a range of 10nm to 45nm.

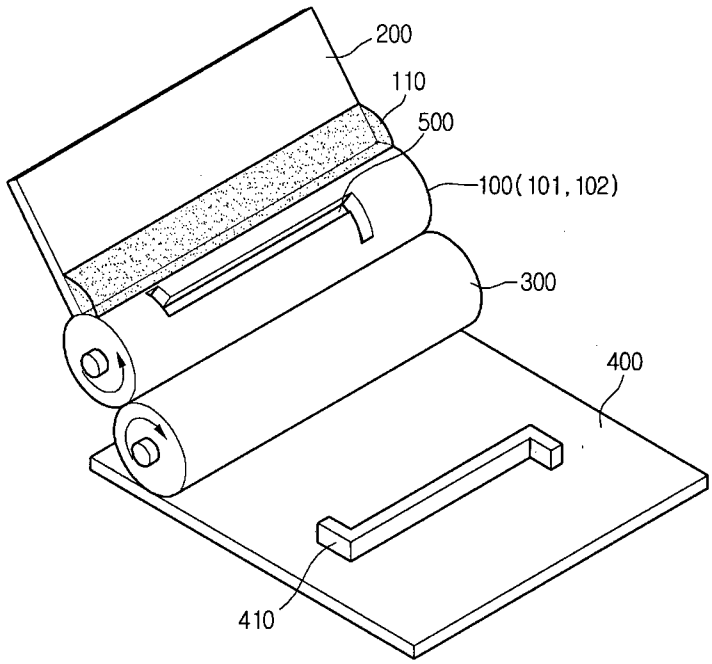
[Claim 17] The method of claim 11, wherein a content of phosphorus (P) in the Ni-P alloy layer is in a range of 10 wt% to 20 wt%.

[Claim 18] The method of claim 11, wherein, in the forming of the Ni-P alloy layer, the Ni-P alloy layer includes tungsten (W).

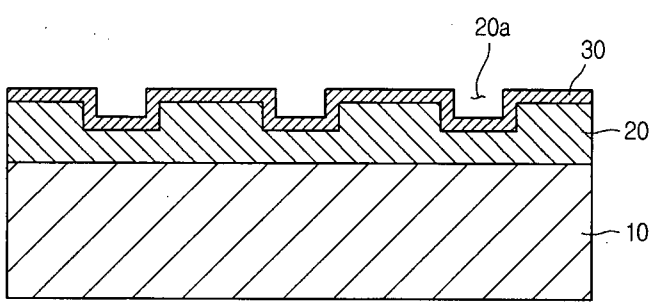
[Claim 19] The method of claim 18, wherein a content of the tungsten (W) is in a range of 1 wt% to 20 wt%.

[Claim 20] The method of claim 11, wherein the copper plating layer has a thickness in a range of 50㎛ to 200㎛.

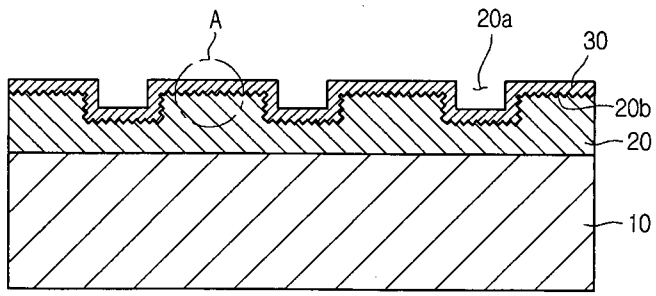
[Fig. 1]



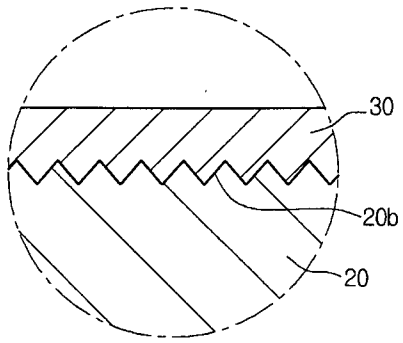
[Fig. 2]



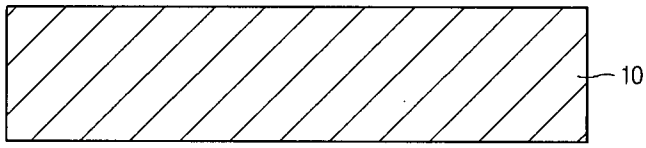
[Fig. 3]



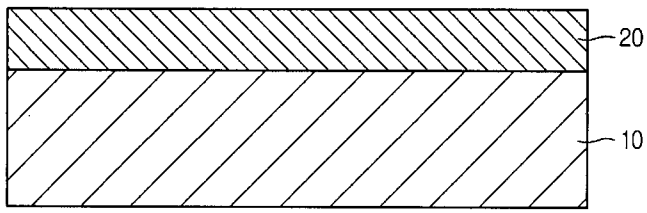
[Fig. 4]



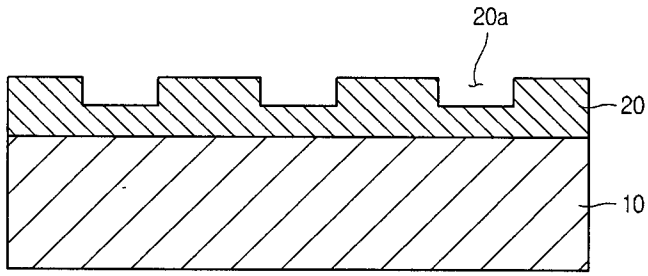
[Fig. 5]



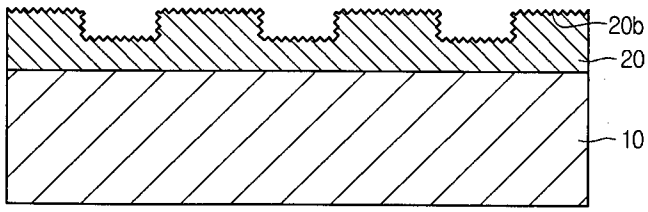
[Fig. 6]



[Fig. 7]



[Fig. 8]



[Fig. 9]