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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
24 April 2014 (24.04.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/059618 Al

(51) International Patent Classification:
B44C 1/04 (2006.01) *C23C 14/04* (2006.01)
B44C 1/22 (2006.01) *C23C 16/04* (2006.01)
B44B 3/00 (2006.01)

(21) International Application Number:
PCT/CN20 12/083074

(22) International Filing Date:
17 October 2012 (17.10.2012)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant: **MICROSOFT CORPORATION** [US/US]; One Microsoft Way, Redmond, Washington 98052-6399 (US).

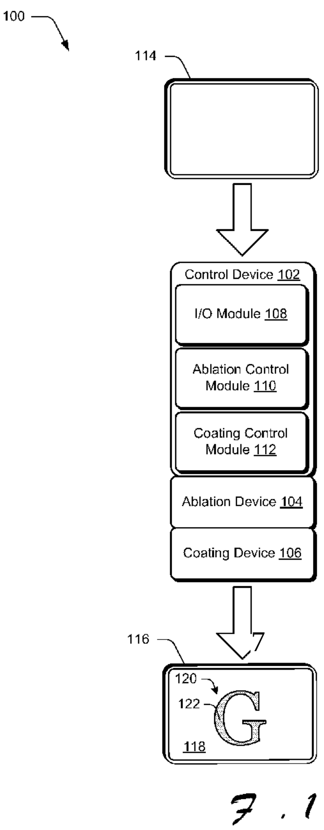
(72) Inventors; and
(71) Applicants *(for US only):* **MCCORMACK, Mark Thomas** [US/US]; Microsoft Corporation One Microsoft Way, Redmond, Washington 98052 (US). **MASTER, Raj N.** [US/US]; Microsoft Corporation One Microsoft Way, Redmond, Washington 98052 (US). **LANE, Michael Joseph** [GB/US]; Microsoft Corporation One Microsoft Way, Redmond, Washington 98052 (US). **DARBHA, Krishna** [US/US]; Microsoft Corporation One Microsoft Way, Redmond, Washington 98052 (US). **GROENE, Ralf** [DE/US]; Microsoft Corporation One Microsoft Way, Redmond, Washington 98052 (US). **ISHIHARA, James Alec** [US/US]; Microsoft Corporation One Microsoft Way, Redmond, Washington 98052 (US). **FISHER, Joshua James** [GB/CN]; Microsoft Corporation One Microsoft Way, Redmond, Washington 98052 (US).

(74) Agent: **SHANGHAI PATENT & TRADEMARK LAW OFFICE, LLC;** 435 Guiping Road, Shanghai 200233 (CN).

(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, BN, 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, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI,

[Continued on next page]

(54) Title: GRAPHIC FORMATION VIA MATERIAL ABLATION



(57) Abstract: Techniques for graphic formation via material ablation described. In at least some implementations, a graphic is applied to a surface of an object by ablating layers of the object to form an ablation trench in the shape of the graphic. In at least some embodiments, an object can include a surface layer and multiple sublayers of materials. When an ablation trench is generated in the object, the ablation trench can penetrate a surface layer of the object and into an intermediate layer. In at least some implementations, height variations in an object surface caused by an ablation trench can cause variations in light reflection properties such that a graphic applied via the ablation trench appears at a different color tone than a surrounding surface, even if the ablation trench and the surrounding surface are coated with a same colored coating.

WO 2014/059618 A1

NO, NZ, OM, PA, 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, 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:

— *with international search report (Art. 21(3))*

Graphic Formation via Material Ablation

BACKGROUND

[0001] Many products include some form of graphic ornamentation, such as for decoration, to identify a source of a product (e.g., a logo), to indicate functionality associated with a product, and so on. A variety of techniques can be utilized to apply graphics to a product.

[0002] For instance, a graphic can be applied via a printed item that is adhered to a surface of a product using a suitable adhesive. One example of such as graphic is a decal. While decals can be convenient to produce and apply, they can often be easily damaged and/or removed.

[0003] Various types of coatings (e.g., paint or other liquid coating) can also be utilized to apply graphics. A graphic applied with a coating may also be easily damaged, and thus detract from the appearance of the graphic.

[0004] Screen printing is another technique that can be employed to apply a graphic to a product. While screen printing is useful in certain scenarios, it can introduce complexity into a production process that can increase product cost and/or production time for bringing a product to market. Thus, many current techniques for applying graphics suffer from a number of drawbacks.

SUMMARY

[0005] This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of

the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

[0006] Techniques for graphic formation via material ablation described. In at least some implementations, specifications are provided (e.g., via user input) for a graphic to be applied to a surface of an object. The graphic, for instance, can be some form of an image, such as a logo, a visual pattern and/or design, a word and/or phrase, artwork, and so on. Further, the object can be configured as an instance of a wide variety of different objects, such as a computing device (e.g., a mobile computing device), a toy, a vehicle, and/or any other object that includes a surface upon which a graphic can be applied. Based on the specifications for the graphic, an ablation trench in the shape of the graphic can be applied to a surface of the object. In at least some implementations, the ablation trench is generated by removing material from the surface of the object in the shape of the graphic, such as via laser ablation.

[0007] In at least some embodiments, an object can include a surface layer and multiple sublayers of materials. For instance, the object can be plated with different layers, such as metals, metal alloys, resins, and so forth. When an ablation trench is generated in the object, the ablation trench can penetrate a surface layer of the object and into an intermediate layer. For instance, a lowermost portion (e.g., bottom) of the ablation trench can penetrate into the intermediate layer, without penetrating a lower layer beneath the intermediate layer. In at least some implementations, this can enable a coating that will adhere to the ablation trench (e.g., the material of the intermediate layer) to be applied to the ablation trench and the object surface. The coating, for instance, can be a thin colored coating that can apply color to the ablation trench and the surround surface of the object.

[0008] In at least some implementations, height variations in an object surface caused by an ablation trench can cause variations in light reflection properties such that a graphic applied via the ablation trench appears at a different color tone than a surrounding surface, even if the ablation trench and the surrounding surface are coated with a same colored coating.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The detailed description is described with reference to the accompanying figures. In the figures, the left-most digit(s) of a reference number identifies the figure in which the reference number first appears. The use of the same reference numbers in different instances in the description and the figures may indicate similar or identical items. Entities represented in the figures may be indicative of one or more entities and thus reference may be made interchangeably to single or plural forms of the entities in the discussion.

[0010] FIG. 1 is an illustration of an environment in an example implementation that is operable to employ the techniques described herein in accordance with one or more embodiments.

[0011] FIG. 2 depicts an example implementation scenario of techniques discussed herein in accordance with one or more embodiments.

[0012] FIG. 3 depicts a magnified sectional view of an object processed according to techniques discussed herein and in accordance with one or more embodiments.

[0013] FIG. 4 depicts an example implementation scenario of techniques discussed herein in accordance with one or more embodiments.

[0014] FIG. 5 illustrates a flow diagram that describes steps in a method in accordance with one or more embodiments.

[0015] FIG. 6 illustrates an example system including various components of an example device that can be implemented as any type of computing device as described with reference to FIG. 1 to implement embodiments of the techniques described herein.

DETAILED DESCRIPTION

Overview

[0016] Techniques for graphic formation via material ablation described. In at least some implementations, specifications are provided (e.g., via user input) for a graphic to be applied to a surface of an object. The graphic, for instance, can be some form of an image, such as a logo, a visual pattern and/or design, a word and/or phrase, artwork, and so on. Further, the object can be configured as an instance of a wide variety of different objects, such as a computing device (e.g., a mobile computing device), a toy, a vehicle, and/or any other object that includes a surface upon which a graphic can be applied. Based on the specifications for the graphic, an ablation trench in the shape of the graphic can be applied to a surface of the object. In at least some implementations, the ablation trench is generated by removing material from the surface of the object in the shape of the graphic, such as via laser ablation.

[0017] In at least some embodiments, an object can include a surface layer and multiple sublayers of materials. For instance, the object can be plated with different layers, such as metals, metal alloys, resins, and so forth. When an ablation trench is generated in the object, the ablation trench can penetrate a surface layer of the object and into an intermediate layer. For instance, a lowermost portion (e.g., bottom) of the ablation trench can penetrate into the intermediate layer, without penetrating a lower layer beneath the intermediate layer. In at least some implementations, this can enable a coating that will adhere to the ablation trench (e.g., the material of the intermediate layer) to be applied to the ablation trench and the object surface. The coating, for instance, can be a thin colored coating that can apply color to the ablation trench and the surround surface of the object.

[0018] In at least some implementations, height variations in an object surface caused by an ablation trench can cause variations in light reflection properties such that a graphic applied via the ablation trench appears at a different color tone than a surrounding surface, even if the ablation trench and the surrounding surface are coated with a same colored coating.

[0019] In the following discussion, a section entitled "Example Environment" discusses an example environment that may employ techniques described herein. Embodiments discussed herein are not limited to the example environment, and the example environment is not limited to embodiments discussed herein. Next, a section entitled "Example Implementation Scenarios" discusses some example implementation scenarios in accordance with one or more embodiments. Following this, a section entitled "Example Procedure" describes an example procedure in accordance with one or more embodiments. Finally, an example system and device are discussed that may implement various techniques described herein.

Example Environment

[0020] FIG. 1 is an illustration of an environment 100 in an example implementation that is operable to employ the techniques described herein. The environment 100 includes a control device 102, which can be configured as a computing device that is capable of performing various operations. One example implementation of the control device 102 is discussed below with reference to FIG. 6.

[0021] The control device 102 includes and/or is operably associated with an ablation device 104, which is configured to remove material from an object surface and/or other layer according to techniques discussed herein. For instance, the ablation device 104 can include a mechanism capable of generating a laser that can be controlled to remove material from an object. A variety of other ablation mechanisms and/or techniques may be employed within the spirit and scope of the claimed embodiments.

[0022] The control device 102 further includes and/or is further operably associated with a coating device 106, which is representative of functionality to apply various types of coatings to objects. Examples of suitable coatings which may be applied via the coating device 106 include thin films (e.g., via physical vapor deposition (PVD), chemical vapor deposition (CVD), and so on), anti-fingerprint (AFP) coatings (e.g., lipophobic and/or hydrophobic coatings), nano-coatings, and so on.

[0023] An input/output (I/O) module 108 and an ablation control module 110 are further included. The I/O module 108 is configured to receive various types of input, such as input from a user, another device, a data storage medium, and so on. In at least some implementations, input to the I/O module 108 can include specifications for a graphic to be applied to an object. For instance, the specifications can include dimensions for a graphic, such as width, length, ablation depth, and so on. Input to the I/O module 108 may also include coating specifications, such as coating type, color specifications, coating depth, and so on.

[0024] The ablation control module 110 represents functionality to control various operations of the ablation device 104. In at least some implementations, the ablation control module 110 can represent a driver that provides an interface to the ablation device 104 from the I/O module 108.

[0025] A coating control module 112 is further included, which represents functionality to control operation of the coating device 106. For instance, the coating control module 112 can represent a driver that provides an interface to the coating device 106 from the I/O module 108.

[0026] The environment 100 further includes an object 114, which is representative of an instance of various physical objects upon which graphics can be applied according to techniques discussed herein. The object 114, for instance, can be configured as a wide variety of different objects, such as a computing device (e.g., a mobile computing device), a toy, a vehicle, and/or any other object that includes a surface upon which a graphic can be applied.

[0027] Further illustrated in the environment 100 is that the object 114 is processed by the control device 102 to produce a marked object 116. The marked object 116 includes a surface 118 upon which a graphic 120 is applied according to techniques discussed herein.

[0028] For instance, the I/O module 108 receives input (e.g., user input) that includes specifications for the graphic 120, e.g., ablation coordinates to be applied to the surface 118. The specifications are passed to the ablation control module 110, which controls operation of the ablation device 104 to remove material from the surface 118. Control of the ablation device 104 can include control of various operational attributes, such as laser power (e.g., flux), laser pulse duration and/or frequency, physical movement of the ablation device 104 relative to the surface 118, and so forth.

[0029] Removal of the material creates an ablation trench 122 in the surface 118 in the shape of the graphic 120. The ablation trench 122 represents a perforation in a surface plane of the surface 118 caused by the removal of the material. As detailed below, depth of the ablation trench 122 can be specified to attain various visual and/or physical properties for the marked object 116 and/or the graphic 120.

[0030] After ablation of the surface 118 to create the graphic 120, the surface 118 may be coated by the coating device 106 with one or more types of coatings. In at least some implementations, application of a coating can tint and/or color the surface 118 and the graphic 120. Application of a coating can also increase surface durability, such as by providing resistance to fingerprinting, scratch resistance, and so on.

Example Implementation Scenarios

[0031] This section discusses some example implementations scenarios in accordance with various embodiments.

[0032] FIG. 2 illustrates an example implementation scenario 200 according to techniques described herein. The upper portion of the scenario 200 illustrates a side view of an object 202 with a surface 204. Also illustrated is a partial cutaway view of the object 202, which reveals layering of material beneath the surface 204. In this example, the object 202 includes a surface layer 206, the top portion of which forms the surface 204. Beneath the surface layer 206 are a first sublayer 208 and a second sublayer 210. The second sublayer 210 is placed on a substrate 212. In at least some implementations, the substrate 212 can form at least a portion of an internal portion of the object 202, such as a housing for the object. For instance, with reference to a mobile computing device implementation, the substrate 212 can form an internal surface of a chassis for the mobile computing device.

[0033] The substrate 212, the surface layer 206, and the sublayers 208, 210 can be formed from various materials, such as metals, alloys, compounds, resins, and so forth. In this particular example, the substrate 212 is formed from a magnesium alloy. However, substrates formed from other materials may be employed as well, such as different metals and/or metal alloys.

[0034] In at least some embodiments, the substrate 212 can be treated to improve adhesion properties for subsequent layers. For instance, the substrate 212 can be treated using a zincate process (e.g., a double zincate process) to deposit zinc on the surface of the substrate 212 prior to application of the second sublayer 210 to the substrate 212. Zinc deposition on the substrate 212 can improve adhesion of the second sublayer 210 to the substrate 212.

[0035] Further to the scenario 200, the surface layer 206 and the sublayers 208, 210 are adhered to the substrate 212, such as utilizing various types of deposition and/or plating processes. For instance, in at least one embodiment the second sublayer 210 is formed from copper, such as from one or more forms of elemental copper, copper compounds, and so on. Further, the first sublayer 208 is formed from nickel, such as from one or more forms of elemental nickel, nickel compounds, and so on. The surface layer 206 can be formed from chromium, such as from one or more forms of elemental chromium, chromium compounds, and so on. Thus, in a least some implementations, the surface layer 206, the first sublayer 208, and the second sublayer 210 can be adhered to the substrate 212 to form distinct layers of different materials.

[0036] Further to one or more embodiments, the surface layer 206, the first sublayer 208, and the second sublayer 210 can be applied according to various thicknesses and thickness variations. For instance, consider the following example specifications for each of the respective layers.

[0037] (1) Second sublayer 210 - applied to the substrate 212 at 20 micrometers ("μ") thickness, with a tolerance of +15μ and -15μ.

[0038] (2) First sublayer 208 - applied to the second sublayer 210 at 9μ thickness, with a tolerance of +/- 5μ.

[0039] (3) Surface layer 206 - applied to the first sublayer 208 at O.ï μ - 0.3μ thickness.

[0040] Proceeding to the lower portion of the scenario 200, the surface 204 is ablated (e.g., using the ablation device 104) to generate an ablation trench 214. The ablation trench 214 is created by removing material from the surface layer 206 and one or more of the sublayers to create a perforation in the surface 204. Although only a cross section of the ablation trench 214 is illustrated, the ablation trench 214 in its entirety corresponds to a pre-specified graphic. For instance, the ablation trench 214 can correspond to a shape for a particular graphic, such as the graphic 120 discussed above with reference to environment 100.

[0041] In this particular example, the ablation trench 214 passes through the surface layer 206 and into the first sublayer 208, without penetrating an interface between the first sublayer 208 and the second sublayer 210. Thus, the depth of the ablation trench 214 is such that a bottom the ablation trench 214 is within the first sublayer 208, and such that the second sublayer 210 remains covered (e.g., sealed) by the first sublayer 208. In at least some implementations, the ablation trench penetrates the first sublayer 208 at a depth range of 2μ-4μ. However, different penetration depths may be employed according to various embodiments.

[0042] FIG. 3 illustrates a magnified section 300 of the side view of the object 202, discussed above. Included as part of the section 300 are the surface 204, the surface layer 208, and the first sublayer 208. Further illustrated is an ablation trench 302.

[0043] In this particular example, the ablation trench 302 includes surface variations 304 that result in varying depth for the ablation trench 302. For instance, the surface variations 304 can cause the penetration depth of the ablation trench 302 into the first sublayer 208 to vary between 1μ-4μ. In implementations where a coating is applied to the ablation trench 302 (as discussed below), the surface variations 304 can cause variations in optical properties of a graphic generated using the ablation trench 302. For instance, the surface variations 304 can increase the number and variation in reflective surfaces such that variations in light reflection and/or scattering occur.

[0044] In at least some implementations, the surface variations 304 can be caused by variations in ablation. For instance, the ablation control module 110 can vary the power, distance (e.g., from the surface 204), and/or the angle of the ablation device 104 during an ablation process, thus resulting in the surface variations 304. Variations in power, for instance, can be caused by pulsing the ablation device 104 (e.g., laser pulsing) at different power levels during an ablation process.

[0045] Having discussed an example implementation scenario that employs object ablation, consider now an example implementation scenario for object coating.

[0046] FIG. 4 illustrates an example implementation scenario 400 according to techniques described herein. In the upper portion of the scenario 400, the partial cutaway view of the object 202 as illustrated in FIG. 2 is presented, including the ablation trench 214 generated via ablation of portions of the object 202.

[0047] Proceeding to the lower portion of the scenario 400, several coating layers are applied to the surface 204, such as via the coating device 106 discussed above with reference to environment 100. In this particular example, a first coating layer 402 is applied to the surface 204. The first coating layer 402 can include tinting and/or coloring that can change the optical appearance of the surface 204. In an example implementation, the first coating layer 402 can be a colored thin film, such as applied via PVD, CVD, and so forth. For instance, the first coating layer 402 can be applied using a chrome carbide PVD with a coloring agent to achieve a particular color for the first coating layer 402.

[0048] The first coating layer 402 can be applied to the surface 204, including the ablation trench 214, at an approximately consistent thickness. For instance, the first coating layer can be applied at a thickness that ranges from 0.8μ-1.2μ. Thus, the first coating layer 402 can be applied such that the surface 204 and the ablation trench 214 are uniformly colored.

[0049] Further to the scenario 400, a second coating layer 404 is applied on top of the first coating layer 402. The second coating layer 404 can be a protective material, such as an AFP coating, a scratch-resistance coating, a nano-coating, and so forth. For instance, the second coating layer 404 can be applied as a protectant for the first coating layer 402 and/or other layers, such as to prevent fingerprint adhesion, resist surface scratching, and so forth.

[0050] According to one or more embodiments, the second coating layer 404 can be applied to the first coating layer 402 at an approximately uniform thickness. For instance, the thickness of the second coating layer 404 can range from 0.25μ-1.50μ.

[0051] In at least some implementations, color measurement of the surface 204 and the ablation trench 214 when coated with the first coating layer 402 and the second coating layer 404 (e.g., using a suitable color meter) can indicate that the surface 204 and the ablation trench 214 are the same color. Differences in surface height between the surface 204 and the ablation trench 214, however, can result in differences in light reflection properties. For instance, specular and/or other reflection properties in response to incident light on the surface 204 and the ablation trench 214 can differ, causing visual color tonal differences between the surfaces. This can cause visually perceptible color differences between a graphic applied via the ablation trench 214 and a surrounding surface (e.g., the surface 204), even though the ablation trench 214 and the surrounding surface are coated with the same color.

[0052] Surface variations in the ablation trench 214 (e.g., as discussed above), may also contribute to differences in color perception between the surface 204 and the ablation trench 214. As referenced above, such surface variations can cause variable light reflection and/or scattering properties in the ablation trench 214. Such variable light properties can result in a visual perception of variation in color between the surface 204 and the ablation trench 214, even though both may be coated with a uniformly colored coating.

[0053] The example thicknesses and tolerances discussed above are presented for purpose of example only, and a wide variety of different layer thicknesses and tolerances can be employed within the spirit and scope of the claimed embodiments.

Example Procedure

[0054] The following discussion describes an example procedure in accordance with one or more embodiments. In portions of the following discussion, reference will be made to the environment 100 and the implementation scenarios discussed above.

[0055] FIG. 5 is a flow diagram that describes steps in a method in accordance with one or more embodiments. Step 500 receives specifications for a graphic to be applied to a surface of an object. For example, the I/O module 108 can receive input that includes various specifications for a graphic, such as a pattern for a graphic in terms of x and y coordinates. The specifications may also include an ablation depth and/or variations in ablation depth to be used to apply the graphic to the surface.

[0056] Step 502 ablates the surface of the object based on the specifications to generate an ablation trench that corresponds to the graphic. For instance, the specifications can be provided from the I/O module 108 to the ablation control module 110, which controls operation of the ablation device 104 to ablate the surface according to the specifications.

[0057] As discussed above, the object can include multiple layers of material layered on top of a substrate. Further, the ablation trench can penetrate a surface layer in the shape of the specified graphic. The trench depth can be specified such that a lowermost portion of the trench penetrates an intermediate layer without penetrating one or more lower layers.

[0058] Step 504 coats the ablation trench and surrounding surface of the object with a finish coating. For instance, specifications for one or more coatings to be applied can be provided to the I/O module 108, which can provide the coating specifications to the coating control module 112. The coating control module 112 can control operation of the coating device 106 to apply a coating to the ablation trench and surrounding surfaces. Examples of finish coatings are discussed above, such as PVDs, AFPs, and so forth. As also discussed above, a finish coating can be tinted such that coloring is applied to the surface of the object and the ablation trench.

Example System and Device

[0059] FIG. 6 illustrates an example system generally at 600 that includes an example computing device 602 that is representative of one or more computing systems and/or devices that may implement the various techniques described herein. The computing device 602 may be, for example, be configured to assume a mobile configuration through use of a housing formed and size to be grasped and carried by one or more hands of a user, illustrated examples of which include a mobile phone, mobile game and music device, and tablet computer although other examples are also contemplated.

[0060] The example computing device 602 as illustrated includes a processing system 604, one or more computer-readable media 606, and one or more I/O interface 608 that are communicatively coupled, one to another. Although not shown, the computing device 602 may further include a system bus or other data and command transfer system that couples the various components, one to another. A system bus can include any one or combination of different bus structures, such as a memory bus or memory controller, a peripheral bus, a universal serial bus, and/or a processor or local bus that utilizes any of a variety of bus architectures. A variety of other examples are also contemplated, such as control and data lines.

[0061] The processing system 604 is representative of functionality to perform one or more operations using hardware. Accordingly, the processing system 604 is illustrated as including hardware element 610 that may be configured as processors, functional blocks, and so forth. This may include implementation in hardware as an application specific integrated circuit or other logic device formed using one or more semiconductors. The hardware elements 610 are not limited by the materials from which they are formed or the processing mechanisms employed therein. For example, processors may be comprised of semiconductor(s) and/or transistors (e.g., electronic integrated circuits (ICs)). In such a context, processor-executable instructions may be electronically-executable instructions.

[0062] The computer-readable storage media 606 is illustrated as including memory/storage 612. The memory/storage 612 represents memory/storage capacity associated with one or more computer-readable media. The memory/storage component 612 may include volatile media (such as random access memory (RAM)) and/or nonvolatile media (such as read only memory (ROM), Flash memory, optical disks, magnetic disks, and so forth). The memory/storage component 612 may include fixed media (e.g., RAM, ROM, a fixed hard drive, and so on) as well as removable media (e.g., Flash memory, a removable hard drive, an optical disc, and so forth). The computer-readable media 606 may be configured in a variety of other ways as further described below.

[0063] Input/output interface(s) 608 are representative of functionality to allow a user to enter commands and information to computing device 602, and also allow information to be presented to the user and/or other components or devices using various input/output devices. Examples of input devices include a keyboard, a cursor control device (e.g., a mouse), a microphone, a scanner, touch functionality (e.g., capacitive or other sensors that are configured to detect physical touch), a camera (e.g., which may employ visible or non-visible wavelengths such as infrared frequencies to recognize movement as gestures that do not involve touch), and so forth. Examples of output devices include a display device (e.g., a monitor or projector), speakers, a printer, a network card, tactile-response device, and so forth. Thus, the computing device 602 may be configured in a variety of ways to support user interaction.

[0064] The computing device 602 is further illustrated as being communicatively and physically coupled to an input device 614 that is physically and communicatively removable from the computing device 602. In this way, a variety of different input devices may be coupled to the computing device 602 having a wide variety of configurations to support a wide variety of functionality. In this example, the input device 614 includes one or more keys 616, which may be configured as pressure sensitive keys, mechanically switched keys, and so forth.

[0065] The input device 614 is further illustrated as include one or more modules 618 that may be configured to support a variety of functionality. The one or more modules 618, for instance, may be configured to process analog and/or digital signals received from the keys 616 to determine whether a keystroke was intended, determine whether an input is indicative of resting pressure, support authentication of the input device 614 for operation with the computing device 602, and so on.

[0066] Various techniques may be described herein in the general context of software, hardware elements, or program modules. Generally, such modules include routines, programs, objects, elements, components, data structures, and so forth that perform particular tasks or implement particular abstract data types. The terms "module," "functionality," and "component" as used herein generally represent software, firmware, hardware, or a combination thereof. The features of the techniques described herein are platform-independent, meaning that the techniques may be implemented on a variety of commercial computing platforms having a variety of processors.

[0067] An implementation of the described modules and techniques may be stored on or transmitted across some form of computer-readable media. The computer-readable media may include a variety of media that may be accessed by the computing device 602. By way of example, and not limitation, computer-readable media may include "computer-readable storage media" and "computer-readable signal media."

[0068] "Computer-readable storage media" may refer to media and/or devices that enable persistent and/or non-transitory storage of information in contrast to mere signal transmission, carrier waves, or signals per se. Thus, computer-readable storage media refers to non-signal bearing media. The computer-readable storage media includes hardware such as volatile and non-volatile, removable and non-removable media and/or storage devices implemented in a method or technology suitable for storage of information such as computer readable instructions, data structures, program modules, logic elements/circuits, or other data. Examples of computer-readable storage media may include, but are not limited to, RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical storage, hard disks, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or other storage device, tangible media, or article of manufacture suitable to store the desired information and which may be accessed by a computer.

[0069] "Computer-readable signal media" may refer to a signal-bearing medium that is configured to transmit instructions to the hardware of the computing device 602, such as via a network. Signal media typically may embody computer readable instructions, data structures, program modules, or other data in a modulated data signal, such as carrier waves, data signals, or other transport mechanism. Signal media also include any information delivery media. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media include wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared, and other wireless media.

[0070] As previously described, hardware elements 610 and computer-readable media 606 are representative of modules, programmable device logic and/or fixed device logic implemented in a hardware form that may be employed in some embodiments to implement at least some aspects of the techniques described herein, such as to perform one or more instructions. Hardware may include components of an integrated circuit or on-chip system, an application-specific integrated circuit (ASIC), a field-programmable gate array (FPGA), a complex programmable logic device (CPLD), and other implementations in silicon or other hardware. In this context, hardware may operate as a processing device that performs program tasks defined by instructions and/or logic embodied by the hardware as well as a hardware utilized to store instructions for execution, e.g., the computer-readable storage media described previously.

[0071] Combinations of the foregoing may also be employed to implement various techniques described herein. Accordingly, software, hardware, or executable modules may be implemented as one or more instructions and/or logic embodied on some form of computer-readable storage media and/or by one or more hardware elements 610. The computing device 602 may be configured to implement particular instructions and/or functions corresponding to the software and/or hardware modules. Accordingly, implementation of a module that is executable by the computing device 602 as software may be achieved at least partially in hardware, e.g., through use of computer-readable storage media and/or hardware elements 610 of the processing system 604. The instructions and/or functions may be executable/operable by one or more articles of manufacture (for example, one or more computing devices 602 and/or processing systems 604) to implement techniques, modules, and examples described herein.

[0072] Discussed herein are a number of methods that may be implemented to perform techniques discussed herein. Aspects of the methods may be implemented in hardware, firmware, or software, or a combination thereof. The methods are shown as a set of blocks that specify operations performed by one or more devices and are not necessarily limited to the orders shown for performing the operations by the respective blocks. Further, an operation shown with respect to a particular method may be combined and/or interchanged with an operation of a different method in accordance with one or more implementations. Aspects of the methods can be implemented via interaction between various entities discussed above with reference to the environment 100 and/or the example implementation scenarios discussed above.

Conclusion

[0073] Although the example implementations have been described in language specific to structural features and/or methodological acts, it is to be understood that the implementations defined in the appended claims is not necessarily limited to the specific features or acts described. Rather, the specific features and acts are disclosed as example forms of implementing the claimed features.

CLAIMS

What is claimed is:

1. An apparatus comprising:

a housing formed from a substrate;

multiple layers of materials applied on top of the substrate, including a surface layer;

an ablation trench in the shape of a graphic and formed through the surface layer into an intermediate layer of the multiple layers, the ablation trench being formed such that a lowermost portion of the trench is positioned within the intermediate layer without penetrating an interface between the intermediate layer and a lower layer of the multiple layers; and

at least one coating applied to the ablation trench and at least a portion of the surface layer.

2. An apparatus as described in claim 1, wherein the apparatus comprises a computing device, the surface layer comprises an outer surface of the computing device, and the graphic comprises a visual image to be applied to the outer surface.

3. An apparatus as described in claim 1, wherein the surface layer is formed from at least one of chromium or a chromium alloy, the intermediate layer if formed from at least one of nickel or a nickel alloy, and the lower layer is formed from at least one of copper or a copper alloy.

4. An apparatus as described in claim 3, wherein the surface layer is formed at a thickness of 0.1μ to 0.3μ, the intermediate layer if formed at a thickness of 9.0μ +/- 5μ, and the lower layer is formed at a thickness of 20μ +/- 15μ.

5. An apparatus as described in claim 4, wherein the ablation trench is formed such that the ablation trench penetrates the intermediate layer at a depth range of 2μ-4μ.

6. An apparatus as described in claim 1, wherein the at least one coating is colored such that a same color is applied to the ablation trench and the at least a portion of the surface layer.

7. An apparatus as described in claim 1, wherein the at least one coating includes at least one of a physical vapor deposition (PVD) coating, a chemical vapor deposition (CVD) coating, or an anti-fingerprint (AFP) coating.

8. An apparatus as described in claim 1, wherein the at least one coating includes a physical vapor deposition (PVD) coating applied to the ablation trench and the at least a portion of the surface layer, and an anti-fingerprint (AFP) coating applied to the PVD coating.

9. An apparatus as described in claim 1, wherein the ablation trench is formed such that incident light on the ablation trench and the portion of the

surface layer causes variations in light reflection properties between the ablation trench and the portion of the surface layer.

10. A housing comprising:

a substrate;

multiple layers of materials applied on top of the substrate, at least some of the multiple layers being formed from different metals or different metal alloys;

an ablation trench in the shape of a graphic and formed through a surface layer of the multiple layers into an intermediate layer of the multiple layers, the ablation trench being formed such that a lowermost portion of the trench is positioned within the intermediate layer without penetrating an interface between the intermediate layer and a lower layer of the multiple layers; and

at least one colored coating applied to the ablation trench and at least a portion of the surface layer.

11. A housing as described in claim 10, wherein the housing comprises a portion of a computing device, the surface layer comprises an outer surface of the computing device, and the graphic comprises an image to be applied to the outer surface.

12. A housing as described in claim 10, wherein the surface layer is formed from at least one of chromium or a chromium alloy, the intermediate

layer if formed from at least one of nickel or a nickel alloy, and the lower layer is formed from at least one of copper or a copper alloy.

13. A housing as described in claim 12, wherein the surface layer is formed at a thickness of 0.1μ to 0.3μ, the intermediate layer if formed at a thickness of 9.0μ +/- 5μ, and the lower layer is formed at a thickness of 20μ +/- 5μ.

14. A housing as described in claim 13, wherein the ablation trench is formed such that the ablation trench penetrates the intermediate layer at a depth range of 2μ to 4μ.

15. A housing as described in claim 10, wherein the at least one colored coating comprises a physical vapor deposition (PVD) coating applied to the ablation trench and the at least a portion of the surface layer at a thickness that ranges from 0.8μ to 1.2μ.

16. A computer-implemented method comprising:

receiving specifications for a graphic to be applied to a surface of an object, the object including multiple layers of material including a surface layer and multiple layers beneath the surface layer;

ablating the surface of the object based on the specifications to generate an ablation trench that corresponds to the graphic, the ablation trench being ablated such that the ablation trench penetrates the surface layer and a lowermost portion of the trench is positioned within an intermediate layer of the multiple layers without penetrating an interface between the intermediate layer and a lower layer of the multiple layers; and

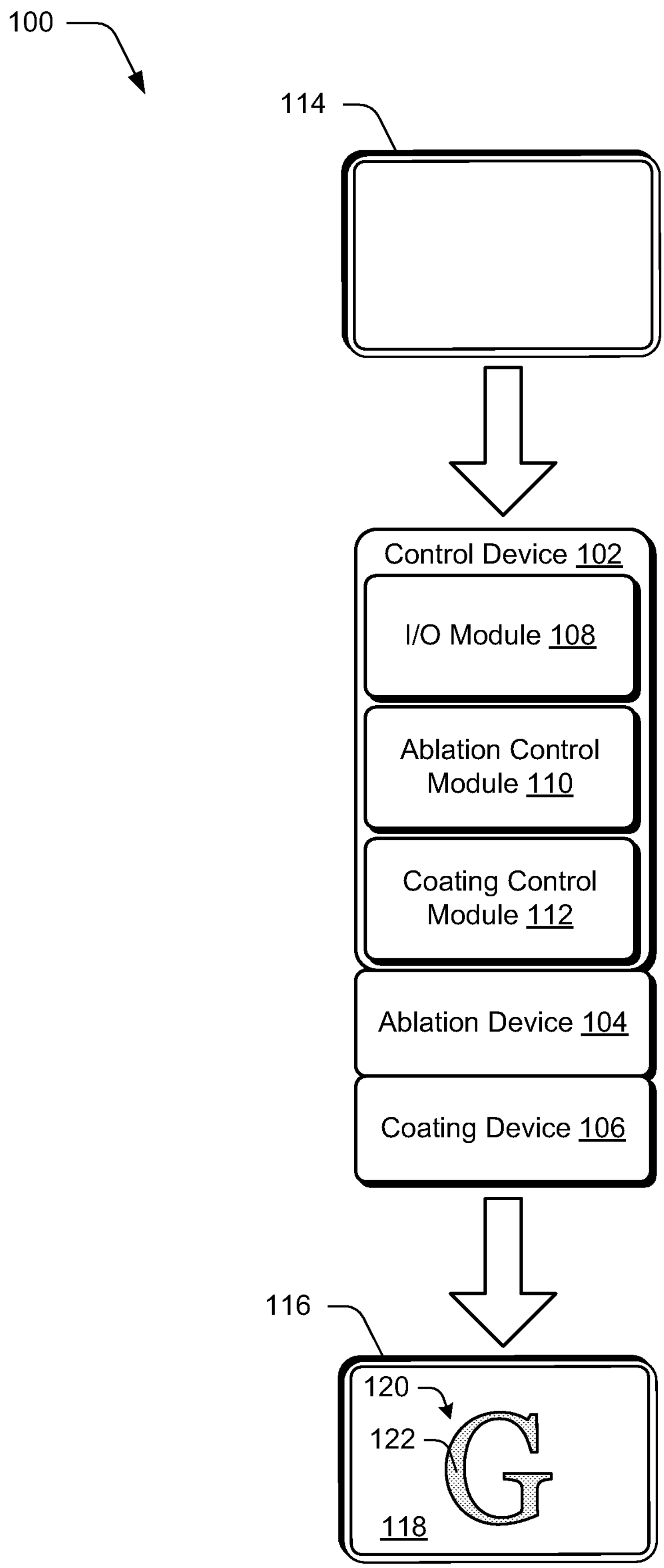
coating the ablation trench and at least a portion of the surface of the object with a coating.

17. A computer-implemented method as described in claim 16, wherein the specifications comprise a pattern for the graphic and at least one of an ablation depth or an ablation depth range for the ablation trench.

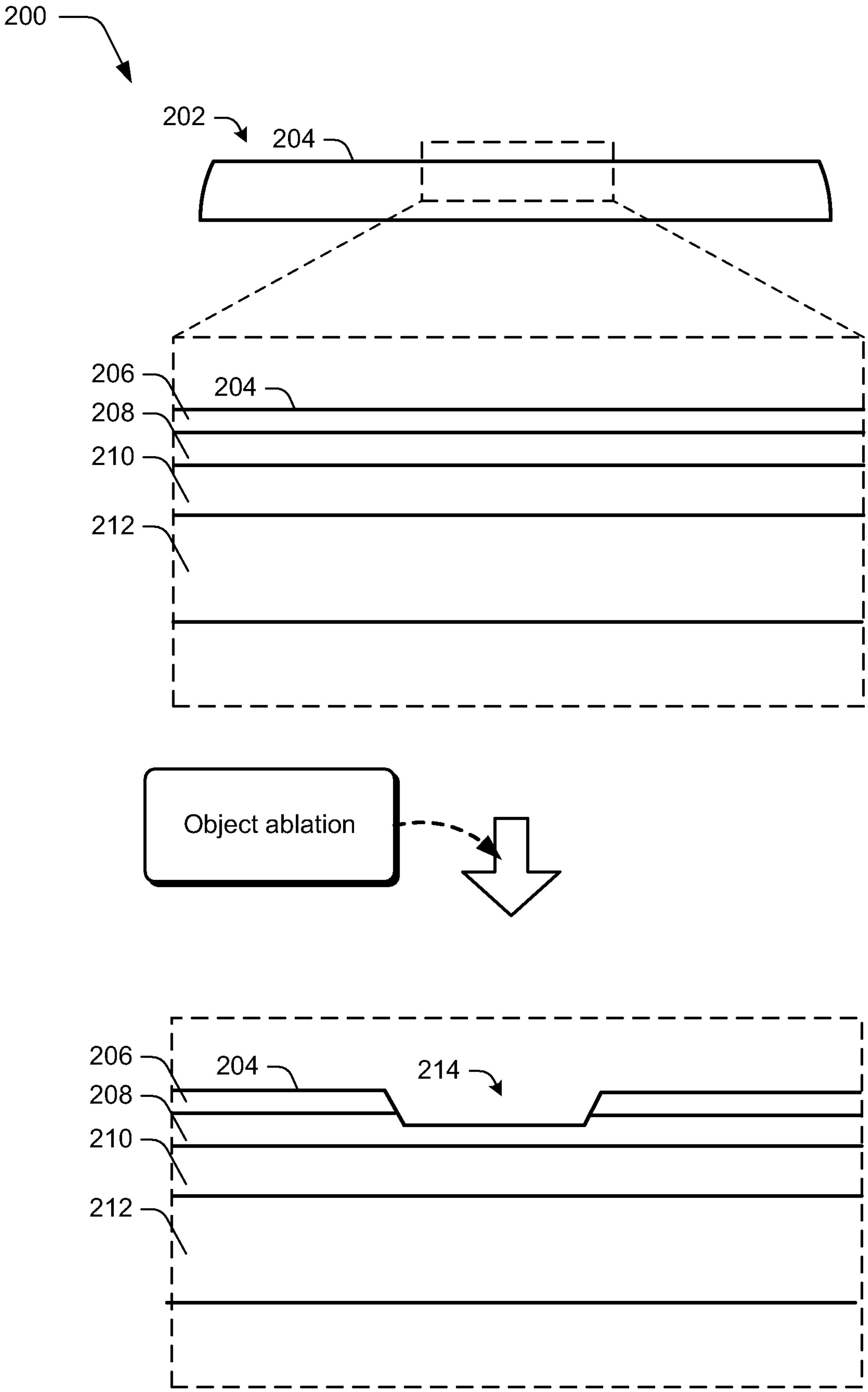
18. A computer-implemented method as described in claim 16, wherein said ablating is implemented via a laser.

19. A computer-implemented method as described in claim 16, wherein the coating comprises a colored vapor deposition coating.

20. A computer-implemented method as described in claim 16, wherein said ablating comprises varying an ablation depth of the ablation trench.


100
114
Control Device 102
I/O Module 108
Ablation Control Module 110
Coating Control Module 112
Ablation Device 104
Coating Device 106
116
120
122
G
118

F. 1


200
202
204
206
204
208
210
212
Object ablation
206
204
214
208
210
212

F . 2

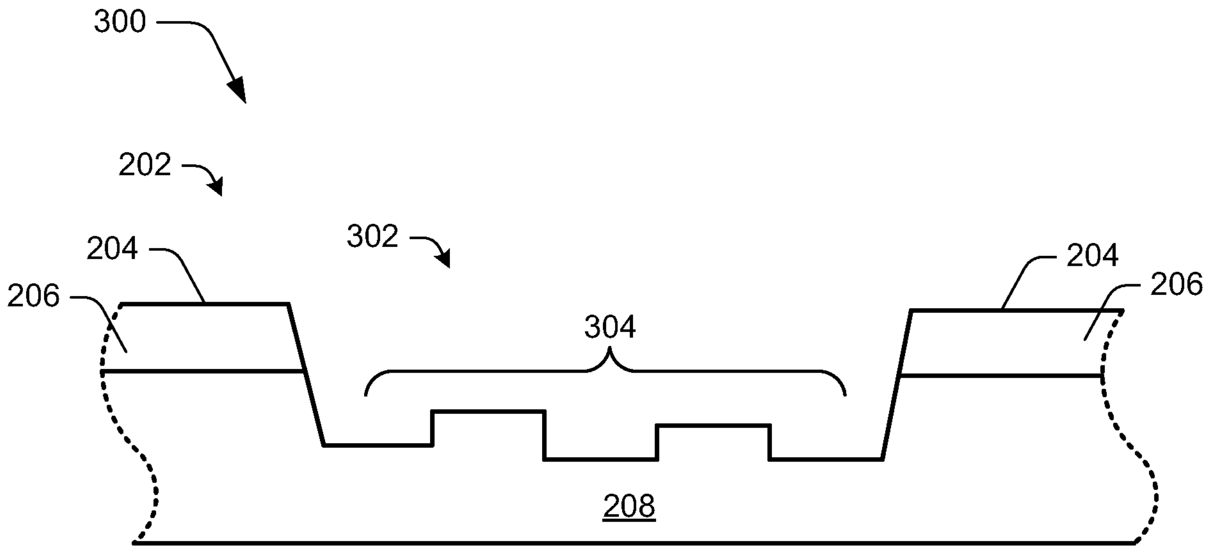
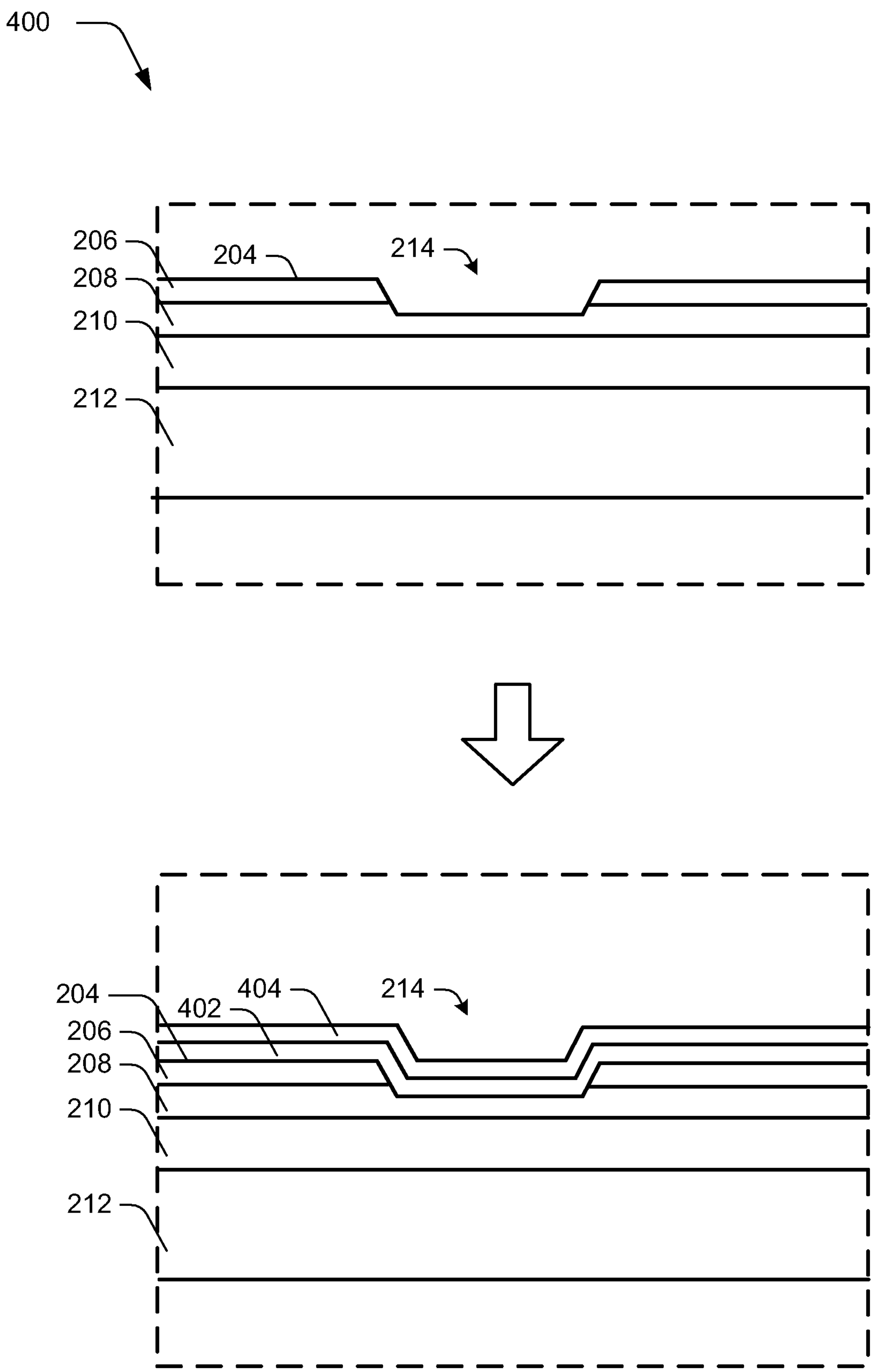
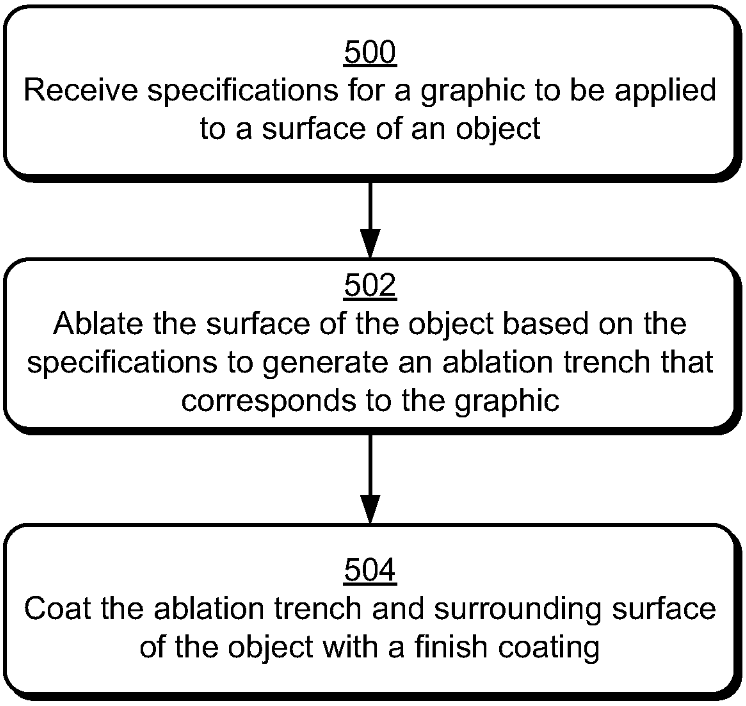


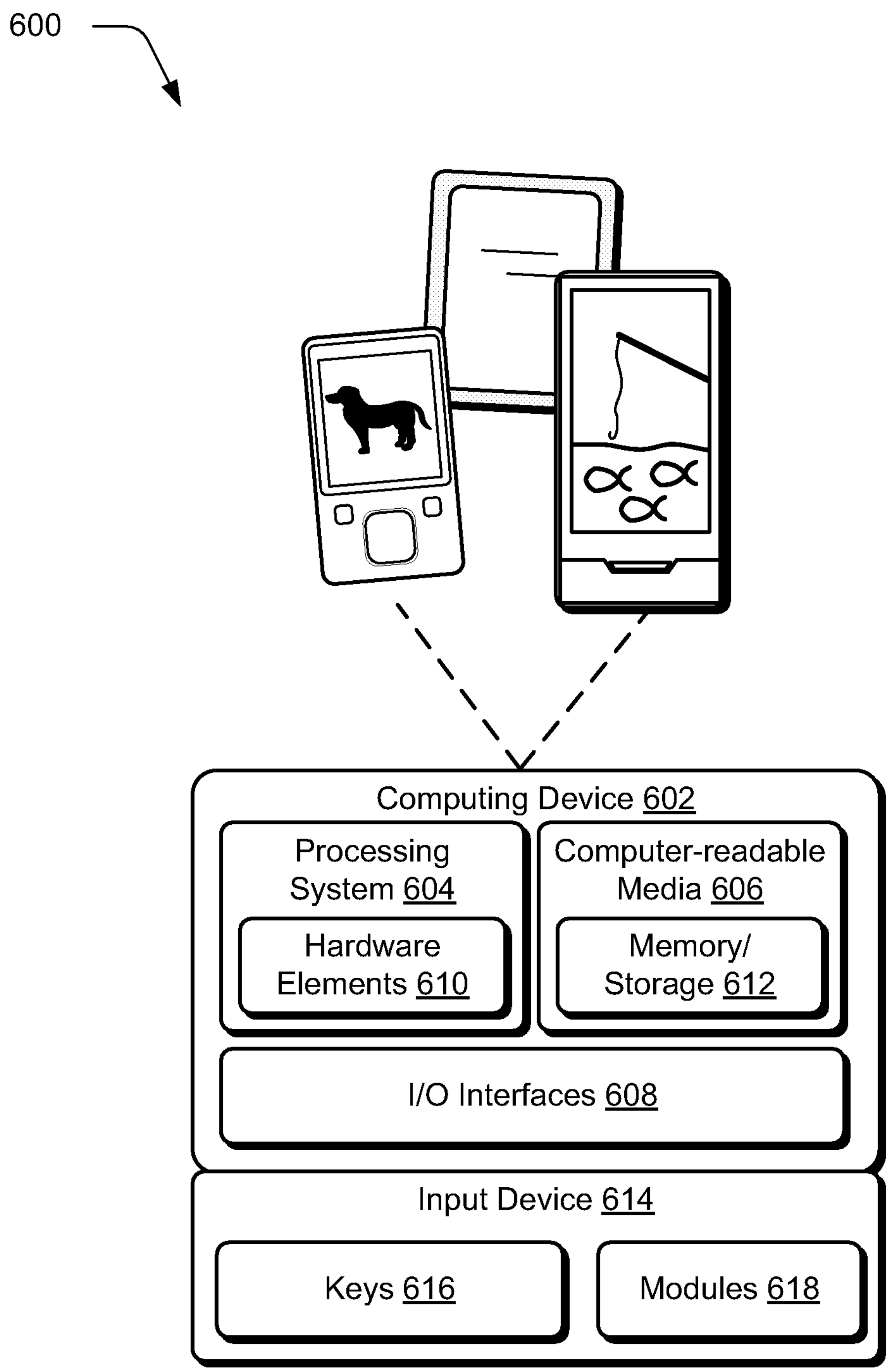
Fig. 3



F. 4


500
Receive specifications for a graphic to be applied to a surface of an object
502
Ablate the surface of the object based on the specifications to generate an ablation trench that corresponds to the graphic
504
Coat the ablation trench and surrounding surface of the object with a finish coating

F. 5


600
Computing Device 602
Processing System 604
Hardware Elements 610
Computer-readable Media 606
Memory/ Storage 612
I/O Interfaces 608
Input Device 614
Keys 616
Modules 618

F. 6

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2012/083074

A. CLASSIFICATION OF SUBJECT MATTER

See the extra sheet

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)

IPC: B44C/-, B44B/-, C23C147-, C23C16/-

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)

DWPI; SIPOABS; CNKI; CNABS;

etch, ablate, erosion, corrosion, multilayer, laminate, intermediate, interface, binder, base, outer, film, coat, layer, CVD, PVD, vapor, deposit, sputter, housing, envelope, casting, shell, pattern, graphics, logo

C. DOCUMENT S CONSIDERED TO BE RELEVANT

Category'*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008318008 A1 (KONTNKLIJKE PHILIPS ELECTRONICS NV) 25 December 2008 (25.08.2008) claims 1 and 10, description, paragraphs [0027] to [0031]	1-20
X	CN 101513812 A (BYD CO LTD) 26 August 2009 (26.08.2009) description, page 4, paragraphs [0002] to [0006], page 5, paragraph [0002]	1-20
X	CN 102582159 A (WINSKY TECHNOLOGY LTD) 18 July 2012 (18.07.2012) claims 1-9	1-15
A	CN 1854944 A (JDS UNIPHASE CORP) 01 November 2006 (01.11.2006) the whole document	1-20

☐ 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	Date of mailing of the international search report
27 June 2013 (27.06.2013)	**25 Jul. 2013 (25.07.2013)**

Name and mailing address of the ISA/CN
The State Intellectual Property Office, the P.R.China
6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China
100088
Facsimile No. 86-10-62019451

Authorized officer

LI, Yinsuo

Telephone No. (86-10)62084754

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2012/083074

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
US 2008318008 A1	2008-12-25	WO 2006025016 A1	2006-03-09
		EP 1796918 A1	2007-06-20
		JP 2008511433 A	2008-04-17
		CN 101014468 A	2007-08-08
		IN 200701336 P4	2007-08-31
CN 101513812A	2009-08-26	None	
CN 102582159A	2012-07-18	None	
CN 1854944 A	2006-11-01	US 7667895 B2	2010-02 23
		CN 1854944 B	2011-02-09
		US 2006077496 A1	2006-04-13
		EP 1715392 A1	2006-10-25
		IN 200600709 I1	2007-08-03
		US 2007058227 A1	2007-03-15
		US 7876481 B2	2011-01-25
		US 2007195392 A1	2007-08-23
		US 2008024847 A1	2008-01-31
		US 7880943 B2	2011-02-01
		US 2009324907 A1	2009-12-31
		US 2012075701 A1	2012-03-29

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2012/083074

A. CLASSIFICATION OF SUBJECT MATTER

B44C l/04 (2006.01) i

B44C l/22 (2006.01) i

B44B 3/00 (2006.01) i

C23C 14/04 (2006.01) i

C23C 16/04 (2006.01) i