THREE-DIMENSIONAL SUPPORTING FRAME

Inventors: Xiaoqi Zhou, San Diego, CA (US); David Edmondson, San Diego, CA (US); Francois K. Pirayesh, San Diego, CA (US)

Assignee: Hewlett-Packard Development Company L.P., Houston, TX (US)

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ABSTRACT

A three-dimensional supporting frame includes a blank, including an image receiving surface, a back surface opposed to the image receiving surface, a center portion defining a perimeter, and at least three foldable extensions extending from the perimeter. Each of the foldable extensions includes no less than four folds to be folded toward the back surface to form the three-dimensional supporting frame. An unfilled adhesive is positioned on the image receiving surface at least at the center portion, and a filled adhesive is positioned on the image receiving surface at each of the folds that is furthest from the perimeter.
THREE-DIMENSIONAL SUPPORTING FRAME

BACKGROUND

[0001] The present disclosure relates generally to a three-dimensional supporting frame.

[0002] The global print market is in the process of transforming from analog printing to digital printing. Inkjet printing and electrophotographic printing are examples of digital printing techniques. These printing techniques have become increasingly popular for printing photographs and/or decorative art items. As examples, an image may be inkjet printed on canvas and then mounted on a wood frame, or an image may be liquid electro-photographically printed on a high gloss medium and then mounted on a metal plate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0003] Features and advantages of examples of the present disclosure will become apparent by reference to the following detailed description and drawings, in which like reference numerals correspond to similar, though perhaps not identical, components. For the sake of brevity, reference numerals or features having a previously described function may or may not be described in connection with other drawings in which they appear.

[0004] FIG. 1A is a front view of an example of a blank used to form an example of a three-dimensional supporting frame;

[0005] FIG. 1B is a semi-schematic cross-sectional view taken along line 1B-1B in FIG. 1A;

[0006] FIG. 2A is a front view of an example of the blank of FIG. 1A having an image receiving medium adhered thereto;

[0007] FIG. 2B is a semi-schematic cross-sectional view taken along line 2B-2B in FIG. 2A;

[0008] FIG. 3A is a back, perspective view of an example of the blank and image receiving medium of FIG. 2A after the blank has been folded to form an example of an art canvas;

[0009] FIG. 3B is a semi-schematic cross-sectional view taken along line 3B-3B in FIG. 3A;

[0010] FIG. 4A is a front view of another example of a blank used to form an example of a three-dimensional supporting frame;

[0011] FIG. 4B is a semi-schematic cross-sectional view taken along line 4B-4B in FIG. 4A;

[0012] FIG. 4C is a back, perspective view of the example of the three-dimensional supporting frame formed from the blank of FIG. 4A after it has been folded;

[0013] FIG. 5 is a front view of another example of a blank used to form an example of a three-dimensional supporting frame; and

[0014] FIG. 6 is a front view of another example of a blank used to form an example of a three-dimensional supporting frame.

DETAILED DESCRIPTION

[0015] Examples of the three-dimensional supporting frame are formed of a blank that, when in its three-dimensional configuration, is suitable for displaying photographs, art images, graphics, text, and/or the like, and/or combinations thereof. The three-dimensional supporting frame includes two different types of adhesives, one of which is unfilled and the other of which is filled. The unfilled adhesive is suitable for securing an image receiving medium to the frame with a thin bond line, ranging from about 12 μm to about 60 μm. The filled adhesive forms a strong and durable adhesion joint between components of the blank with a thicker bond line than the bond line formed using the unfilled adhesive. The bond line formed with the filled adhesive ranges from about 35 μm to about 185 μm. The filled adhesive is suitable for securing the blank in the three-dimensional configuration.

[0016] Referring now to FIG. 1A, an example of the blank 12 is depicted. The blank 12 is pre-cut and scored so that when it is folded, it forms the three-dimensional supporting frame 10 (see FIG. 3A). While the blank 12 shown in FIG. 1A is used to make a rectangular three-dimensional supporting frame 10, it is to be understood that blank 12 may be pre-cut and scored to have any desirable shape. As examples, the blank 12 may be shaped so that when folded, any of the following three-dimensional supporting frames is formed: a square three-dimensional supporting frame, a triangular three-dimensional supporting frame (FIG. 4C), a circular three-dimensional supporting frame, or a polygonal three-dimensional supporting frame (FIG. 15), having five or more sides.

[0017] FIG. 1A is a front view of the blank 12, which has a center portion 14 that includes at least four sides 14a, 14b, 14c, 14d, which define a perimeter P. When the center portion 14 has four sides 14a, 14b, 14c, 14d, the center portion 14 may be square, rectangular, or circular. When the center portion 14 has three sides, the shape of the center portion 14 is a triangle, and when the center portion 14 has more than four sides, the shape of the center portion 14 will depend upon the number of sides (e.g., five sides correspond with a pentagon shaped center portion 14, six sides correspond with a hexagon shaped center portion 14, etc.).

[0018] The blank 12 also has two opposed surfaces, namely an image receiving surface 13 and a back surface 15 (FIG. 1B) that is opposed to the image receiving surface 13.

[0019] A foldable extension 16a, 16b, 16c, 16d, respectively extends from each side 14a, 14b, 14c, 14d, of the center portion 14. The foldable extensions 16a, 16b, 16c, 16d may be scored with fold lines 18 that are meant to guide the folding of the foldable extensions 16a, 16b, 16c, 16d toward the back surface 15. In an example, each foldable extension 16a, 16b, 16c, 16d has no less than four fold lines 18 defining no less than four respective folds. In the example shown in FIG. 1A, there are four folds 1, 2, 3, 4. In this example then, each foldable extension 16a, 16b, 16c, 16d is foldable four times, once along each scored fold line 18. In other examples, it is to be understood that more than four fold lines 18 may be included on any one foldable extension 16a, 16b, 16c, 16d so that the foldable extension 16a, 16b, 16c, 16d is foldable more than four times. The foldable extensions 16a, 16b, 16c, 16d, and the folds 1, 2, 3, 4 may have any suitable shape that allows the folds 1, 2, 3, 4 of the respective foldable extension 16a, 16b, 16c, 16d to be folded toward the back surface 15 to form a three-dimensional frame portion (see 30a, 30b, 30c, and 30d in FIG. 3A). As shown in FIG. 1A, each of the foldable extensions 16a, 16b, 16c, 16d is partially angled at opposed edges so that when the folds 1, 2, 3, 4 are folded (as shown in FIG. 3A), the resulting frame portion 30a, 30b, 30c, and 30d abuts an adjacent frame portion 30a', 30b', 30c', and 30d' at the edges (e.g., frame portion 30a' abuts both frames portion 30a and frame portion 30b'). In an example, the abutting frame portions 30a, 30b, 30c, and 30d' form respective corners of the three-dimensional supporting frame 10.

[0020] The blank 12 may be made of any foldable material with suitable stiffness that can be folded over at least 90° with
the assistance of scoring without cracking and/or breaking. The stiffness of the blank 12 is generally greater than 25 Taber units (gf-cm). In an example, the stiffness of the blank 12 ranges from about 100 Taber units to 3000 Taber units (TAPPI method T489-om). In another example, the stiffness of the blank 12 ranges from about 500 Taber units to 2000 Taber units (TAPPI method T489-om). Stiffness, k, of a body is a measure of the resistance offered by an elastic body to deformation. For an elastic body with a single degree of freedom (for example, stretching or compression of a rod), the stiffness, k, is defined as

\[ k = \frac{F}{\delta} \]

where F is the force applied on the body and \( \delta \) is the displacement produced by the force along the same degree of freedom. Examples of the blank 12 include pure element materials, such as aluminum foil; compounds of multiple elements, such as copper-zinc alloy foil; synthetic polymers, such as toughened polypropylene; natural products, such as cellulosic paper (e.g., cardboard); or composites, such as polyethylene terephthalate/calcium carbonate (PET/CaCO_3) coextruded sheets. Other examples of the foldable material used to make the blank 12 include carton board (e.g., solid bleached board, solid unbleached board), white lined chipboard, liquid packaging board, folding boxboard, container board (e.g., liner board), wall paper substrates, uncoated cover paper, or the like.

[0021] On the image receiving surface 13 of the blank 12, two different adhesives 20 and 22 are applied at different areas. These adhesives 20 and 22 are shown in FIGS. 1A and 1B. In FIG. 1A, the speckles are used to illustrate adhesive 20, and the triangles and squiggly lines are used to illustrate adhesive 22. The first adhesive 20 is referred to herein as an unfilled adhesive, and is applied anywhere on the surface 13 that it is desirable to adhere an image receiving medium (reference numeral 26 in FIGS. 2A and 2B). As examples, the unfilled adhesive 20 may be applied to the center portion 14 alone (as shown in FIGS. 1A and 1B), or to the center portion 14 and each of the folds 1, or to the center portion 14 and each of the folds 1 and 2. The unfilled adhesive 20 may be applied to the center portion 14 and each of the folds 1 or the folds 1 and 2 when it is desirable that the image receiving medium 26 be folded with folds 1 and 2. In these instances, the image receiving medium 26 may have the same shape and size as the center portion 14 and the folds 1 or the folds 1 and 2 of the blank 12. As shown in FIGS. 1A and 1B, the unfilled adhesive 20 is applied to the image receiving surface 13 at the center portion 14 alone.

[0022] The second adhesive 22 is referred to herein as a filled adhesive, and is applied on the image receiving surface 13 at those areas that are to be secured to the back surface 15 when the blank 12 is folded. As examples, the filled adhesive 22 may be applied to each of the folds 4 that is furthest from the perimeter P (as shown in FIGS. 1A and 1B), or to each of the folds 4 that is furthest from the perimeter P and to areas of the folds 3 that are designated to be tabs when the blank is folded (see FIGS. 4A and 4C).

[0023] The adhesives 20 and 22 may be applied to the surface 13 on the desirable areas using an air knife coater, a rod coater, a slot die coater, roll coater, or a film transfer coater. In one example, the adhesives 20 and 22 are respectively applied directly onto release liners (not shown), and then the glued release liners are respectively laminated onto the desired areas of the surface 13 using a laminator. The release liners may protect the adhesives 20 and 22 from contamination and from prematurely adhering. If the release liners were shown in FIGS. 1A and 1B, it is to be understood that the respective adhesives 20 and 22 would be covered by the respective liners.

[0024] The unfilled adhesive 20 may be a solvent-based adhesive or a water-based adhesive. Solvents suitable for the solvent-based adhesive include heptane, toluene, ethyl acetate, pentane-2,4-dione, and alcohols. In some instances, it may be desirable to utilize an aqueous-based water solvable and/or water dispersible adhesive. In an example, the unfilled adhesive 20 is formed of a synthetic polymer with a weight average molecular weight ranging from about 200,000 to about 800,000 when the structure is linear, or ranging from about 300,000 to about 1,500,000 when the structure is branched or cross-linked. The unfilled adhesive 20 may also have a pressure sensitive nature. For example, the unfilled adhesive 20 may have a glass transition temperature (T_g) ranging from about ~70°C to about ~40°C, and a peeling strength equal to or greater than 20 Newton/cm² (e.g., as measured according to an ASTM (f.k.a. the American Society for Testing and Materials) test method, namely ASTM 3330M using an INSTRON® tester).

[0025] Suitable examples of the unfilled adhesive 20 are polycyrlates, polyvinyl ethers, silicone resins, polycrylic resins, elastic hydrocarbon polymers (e.g., nitrile rubbers, butyl rubbers, polyisobutylene, polyisoprenes, etc.). ethylene-vinyl acetate copolymers, or styrene block copolymers (e.g., styrene-butadiene-styrene (SBS), styrene-ethylene-styrene, styrene-butylene-styrene, styrene-ethylene, or styrene-propylene). Some suitable examples of unfilled adhesive 20 may be polymers of acrylate addition monomers, such as C1 to C12 alkyl acrylates and methacrylates (e.g., methyl acrylate, ethyl acrylate, n-propyl acrylate, isopropyl acrylate, n-butyl acrylate, isobutyl acrylate, sec-butyl acrylate, tert-butyl acrylate, 2-ethylhexyl acrylate, octyl acrylate, methyl methacrylate, ethyl methacrylate, n-propyl methacrylate, isopropyl methacrylate, n-butyl methacrylate, isobutyl methacrylate, sec-butyl methacrylate, tert-butyl methacrylate); aromatic monomers (e.g., styrene, phenyl methacrylate, o-tolyl methacrylate, m-tolyl methacrylate, p-tolyl methacrylate, and benzyl methacrylate); hydroxyl containing monomers (e.g., hydroxyethylacrylate and hydroxyethylmethacrylate); carboxylic acid containing monomers (e.g., acrylic acid and methacrylic acid); vinyl ester monomers (e.g., vinyl acetate, vinyl propionate, vinylbenzoate, vinyl pivalate, vinyl-2-ethylhexanoate, and vinyl-verseatate); vinyl benzene monomers; and C1-C12 alkyl acrylamide and methacrylamide (e.g., t-butyl acrylamide, sec-butyl acrylamide, N,N-dimethylacrylamide).

[0026] The unfilled adhesive 20 may be a copolymer of at least two of the monomers listed herein. In an example, the molecular structure of the formed copolymer has soft segments (T_g ranging from about ~70°C to about ~20°C) and small hard segments (T_g ranging from about ~10°C to about 100°C). The copolymer may also include functional monomers, i.e., the chemical groups on the molecular chain can react to form a cross-linked structure. Examples of functional monomers include methacrylic acid, acrylic acid, glycidyl methacrylate, and hydroxyethyl acrylate.
In another example, the unfilled adhesive 20 includes a compound having a structure of unsaturated rings. Examples of such compounds include glycerol ester of abietic acid, pentaerythritol ester of abietic acid, and terpene resins derived from alfa-pineene and beta-pineene.

The unfilled adhesive 20 may be applied to have a coat weight ranging from 25 gsm to about 60 gsm. If the adhesive layer coat weight is less than 25 gsm, the bond strength will decrease, and adhesion failure may result.

The filled adhesive 22 includes a polymeric material, a filler, and a surface treatment agent. The filled adhesive 22 may be applied to have a coat weight ranging from about 30 gsm to about 150 gsm.

The polymeric material of the filled adhesive 22 may be any of the polymers described herein for the unfilled adhesive 20. The polymer material of the filled adhesive 22 may be the same material that is selected for the unfilled adhesive 20 or may be a different material than that selected for the unfilled adhesive 20. As examples, the polymeric material of the filled adhesive may be any of the previously listed polycrylates, elastic hydrocarbon polymers, or silicone resins.

The filler of the filled adhesive 22 may include inorganic particles, organic particles, or combination thereof. In an example, the filler has an average particle size ranging from about 0.5 μm to about 3.0 μm, and the size distribution ranges from about 1.5 to about 4. Examples of inorganic particles include ground calcium carbonate, precipitated calcium carbonate, titanium dioxide, kaolin clay, silica, silicates, alumina trihydrate, or combinations thereof. Examples of organic particles include polypropylene and copolymers thereof, e.g., styrene-ethylene, styrene-propylene, styrene-isoprene-styrene, styrene-ethylene-styrene, styrene-butadiene-styrene, and styrene-butadiene-styrene (SBS), polyethylene and copolymers thereof, e.g., copolymers of ethylenically unsaturated monomers, such as styrene or divinyl benzene, with methyl methacrylate, t-butylmethacrylate, methyl acrylate, ethyl(methyl)acrylate, butyl(methyl)acrylate, 2-ethylhexyl (methyl)acrylate, benzyl(methyl)acrylate, lauryl(methyl)acrylate, oleyl(methyl)acrylate, palmityl(methyl)acrylate, stearyl(methyl) acrylate, hydroxethylmethacrylate and hydroxypropylmethacrylate, polyolefins and copolymers thereof, e.g., copolymers of polyethylene and polypropylene.

The surface treatment agent of the filled adhesive 22 may either be deposited onto the surface of the filler by pre-mixing the surface treatment agent with the fillers before adding the polymeric material, or may be mixed directly into the filled adhesive 22. The surface treatment agent may be any component that improves the bonding between the filler, the polymeric material, and the blank 12. An example of the surface treatment agent is a compound having the following formula:

\[(RO)_2SiR'\rightarrow R^+\]

where RO is hydrolysable in a neutral environment (pH=7) or an acidic environment (pH<7) and includes at least one oxygen atom; R' is chosen from alkyl groups, aromatic groups, and heteroaromatic groups; and R' is a group that can be converted into a functional group. In an example, R' is a group that contains nitrogen. As more specific examples, RO is chosen from alkox groups, such as a methox group (CH₂O---), an ethoxy group (CH₃CH₂O---), and an acetox group (CH₃--C(--O)--O---); and R' is chosen from an amino group, a benzylamino group, an epox group, a melamine group, a mercapto group, a chloropropyl group, and a dissulfido group. Some specific examples of R' include a carboxamide group (---CO---NH₂), a primary amine group (---NH₂), a secondary amine group (---NH---), a tertiary amine group (---NR---), and a pyridine group (e.g., --CNH(N)), that can be converted into cationic pyridinium (e.g., 4-pyridyl, 3-pyridyl, and 2-pyridyl).

It is desirable that the filled adhesive 22 have a glass transition temperature (T_g) ranging from about -70°C to about -40°C, a peeling strength equal to or greater than 45 Newton/cm² (e.g., as measured according to an ASTM (I.e., the American Society for Testing and Materials) test method, namely ASTM 3330M using an INSTRON® tester).

The release liners keeping the adhesives 20 and 22 from prematurely adhering may include a substrate and a release coating deposited on the substrate. The substrate may be a cellulose paper and/or a polymeric film (which may be transparent), such as polyethylene, polypropylene, or polyethylene terephthalate (PET). The release coating is made of material(s) that is/are readily able to delaminate from the adhesives 20 and 22, and does not migrate or transfer to the released material (adhesive 20 and 22) to any significant degree. Examples of the release coating of the release liner include polyacrylates, carboxamides, polyolefins, fluorocarbons, silicones, or combinations thereof.

Referencing now to FIGS. 2A and 2B, an image receiving medium 26 is shown adhered to the center portion 14 of the blank 12 on the image receiving surface 13 via the adhesive 20. When it is desirable to adhere the image receiving medium 26, the release liner may be removed, and the image receiving medium may be aligned with and pressed on the adhesive 20. After the image receiving medium 26 is adhered to the adhesive 20, rubber rollers may be used to apply force to the adhered materials to remove any air bubbles entrapped between the adhered materials.

The image receiving medium 26 may be a foldable material which has a specific surface that is able to receive a digital image (e.g., image 28 shown in FIG. 2A) with high print quality. The specific surface may be made by coating or depositing a digital ink/toner receiving layer onto the outermost surface of a base substrate. In this example, coating or depositing refers to the application of a specifically formulated chemical composition onto the outermost surface of the base substrate of the image receiving medium 26 by a suitable process which includes any type of coating process. The specific surface may also be made by surface treating the base substrate via a physical and/or chemical process (e.g., corona treatment, plasma grafting polymerization and/or acid etching). In this example, surface treating refers to a method for altering the surface structure or morphology chemically and/or physically without applying any foreign composition to cover the surface of the base substrate. The surface treating method modifies the nature of the base substrate surface by changing the surface morphology or changing the surface chemical functional groups.

In one example, the image receiving medium 26 includes a cellulose paper base, and the outermost surface of the cellulose paper base is surface functionalized with a digi-
tal ink/toner receiving layer. The composition of the digital ink/toner receiving layer may include binder(s) (e.g., water-based binders such as polyvinyl alcohol, styrene-butadiene emulsion, acrylonitrile-butadiene latex, or combinations thereof) and inorganic pigment particle(s) (e.g., clay, kaolin, calcium carbonate, or combinations thereof). The digital ink/toner receiving layer may be subjected to an embossing treatment to create a desirable surface texture which is represented by a lay pattern. “Lay” is a measure of the direction of the predominant machining pattern. A lay pattern is a repetitive impression created on the surface of a part. The lay patterns created on the image receiving medium 26 include, for example, vertical patterns, horizontal patterns, radial patterns, circular patterns, isotropic patterns and cross hatched patterns.

[0038] In another example, the image receiving medium 26 is made of a foldable material based on a polymeric film. Examples of suitable polymeric films include polyolefin films (e.g., polyethylene and polypropylene films), polycarbonate films, polynime films, polylethylene (PTFE) films. These polymeric films can be used alone, or they can be co-extruded with another material, such as cellulose paper, to form a foldable image receiving medium. In some examples, the polymeric film surface is pre-coated with an example of the digital ink/toner receiving layer disclosed herein and/or is surface treated to improve the ink reception and toner adhesion.

[0039] In yet another example, the image receiving medium 26 is made of a foldable ductile metal foil. The metal foil may be a pure metal and/or a metal alloy. In some examples, the metal foil surface is pre-coated with an example of the digital ink/toner receiving layer disclosed herein and/or is surface treated to improve the ink reception and toner adhesion.

[0040] Any of the digital ink/toner receiving layers disclosed herein may include components that absorb light in the ultraviolet (UV) and violet region (200 nm to 380 nm) of the electromagnetic spectrum, and re-emit light in the blue region (400 nm to 490 nm). The chemical compounds which are able to absorb and then re-emit include those that have the structure of any of the following: triazine-stilbenes (dithetera- or hexa-sulfonated); coumarins; imidazolines; diazoles; triazoles; benzoaxazolines; or biphenyl-stilbenes. Any of the digital ink/toner receiving layers disclosed herein may also include luminous materials. As an example, when illuminated by the particular wavelength(s) of light for a particular amount of time, the luminous materials will exhibit a specific light effect (e.g., photoluminescence) after the light is removed. Some examples of the luminous materials include Tritium, LumiNova, and Super LumiNova.

[0041] As mentioned above, the image 28 may be created using any suitable digital printing technique. It is believed that the durability of the printed image 28 may be the result of the combination of the medium 26 and the ink or toner that is used. For example, a medium including a digital ink/toner receiving layer or having been surface treated may be desirable when digital electrophotographic printing is used with toners that contain a durable colorant and UV, light and ozone fastness resin binders. In another example, a durable printed image is formed when a pigment inkjet ink is printed, using inkjet technology, onto a micro-porous image receiving medium. In this example, a pigment or any number of pigment blends may be provided in the inkjet ink formulation to impart color to the ink. As such, the pigment may be any number of desired pigments dispersed throughout the resulting inkjet ink. More particularly, the pigment included in the inkjet ink may include self-dispersed (surface modified) pigments, or pigments accompanied by a dispersant.

[0042] FIG. 2A illustrates the front view of the blank 12 having the image receiving medium 26 (with the image 28 printed thereon) adhered thereto. Since the image receiving medium 26 is the same shape and size as the center portion 14, the foldable extensions 16a, 16b, 16c, 16d are visible in this view, as the image receiving medium 26 does not overly any part of the foldable extensions 16a, 16b, 16c. In other examples, it is to be understood that the image receiving medium 26 may be the same shape and size as the center portion 14 and the folds 1, or as the center portion 14 and the folds 1 and 2. In either of these instances, the image receiving medium 26 includes an image receiving portion that is shaped and sized in the same manner as the center portion 14 of the blank 12, and also includes image receiving extensions (including one fold or two folds) that respectively extend from each side of the image receiving portion and correspond with the folds 1 or folds 1 and 2 of the blank 12. The extensions of the image receiving medium may be scored with fold lines so that the folds of the image receiving extension may be folded with the fold 1 or folds 1 and 2 of the blank 12. In instances where the image receiving medium 26 extends onto the fold 1, when folded, the image receiving medium 26 may be seen on the outer wall of the art canvas. In instances where the image receiving medium 26 extends onto the folds 1 and 2, when folded, the image receiving medium 26 may be seen on the outer wall and on the back wall of the art canvas.

[0043] In FIGS. 2A and 2B, it is to be understood that each of the folds 4 of the blank 12 has the adhesive 22 thereon, which may be covered by a release liner.

[0044] Referring now to FIGS. 3A and 3B, the blank 12 having the image receiving medium 26 attached thereto is folded to form the art canvas 100. The folded blank 12 forms the three-dimensional supporting frame 10, and when the image receiving medium 26 is attached thereto, the art canvas 100 is formed.

[0045] When the foldable extensions 16a, 16b, 16c, 16d of the blank 12 are folded, respective three-dimensional frame portions 30a, 30b, 30c, 30d are formed. As depicted in FIG. 3A, each frame portion 30a, 30b, 30c, 30d abuts another frame portion 30a, 30b, 30c, 30d to form the three-dimensional supporting frame 10. The cross-sectional view shown in FIG. 3B illustrates the walls that are formed when the folds 1, 2, 3, 4 are folded.

[0046] To construct the three-dimensional supporting frame 10 and the art canvas 100, fold 1 of each of the extensions 16a, 16b, 16c, 16d is folded inward (i.e., towards the surface 15). The fold 1 of a respective extension 16a, or 16b, or 16c, or 16d forms an outer wall of the respective frame portion 30a, 30b, 30c, or 30d. All together, the folds 1 form the perimeter wall of the three-dimensional supporting frame 10 and the art canvas 100. In some instances, the perimeter wall may be covered by a portion of the image receiving medium 26. Fold 2 of each of the extensions 16a, 16b, 16c, 16d is folded inward (i.e., towards the surface 15). The fold 2 of a respective extension 16a, or 16b, or 16c, or 16d forms a back wall of the respective frame portion 30a, 30b, 30c, or 30d. All together, the folds 2 form the back wall of the three-dimensional supporting frame 10 and the art canvas 100. In some instances, the back wall may be covered by a portion of the image receiving medium 26. Fold 3 of each of
the extensions 16, 16, 16, 16, 16, is then folded inward (i.e., towards the surface 15). The fold 3 of a respective extension 16, or 16, or 16, or 16, or 16, forms an inner wall of the respective frame portion 30, 30, 30, 30, or 30. All together, these folds 3 form the inner perimeter wall of the three-dimensional supporting frame 10 and the art canvas 100. Finally, fold 4 of each of the extensions 16, 16, 16, 16, 16, is then folded inward (i.e., towards the surface 15). These folds 4 are adhered to the surface 15 of the blank 12 at the center portion 14 via the adhesive 22. When folding the blank 12, any release liner on the adhesives 22 would be removed prior to contacting the adhesive 22 with the surface 15.

While not shown, it is to be understood that a support material may be inserted into the three-dimensional supporting frame 10 adjacent to the surface 15 at the center portion 14. The support material may be the same material as the blank 12, or it may be another strengthening material that adds support, but not significant weight, to the art canvas 100. The support material may or may not be adhered to the center portion 14.

FIGS. 4A and 4B depict another example of the blank 12, with the adhesives 20 and 22 applied thereon in desirable areas. In FIG. 4A, the specal dots are again used to illustrate adhesive 20 and the triangles and squiggly lines are again used to illustrate adhesive 22. FIG. 4C depicts another example of the three-dimensional supporting frame 10, formed from the folded blank 12.

FIG. 4A depicts a front view of the triangulated shaped blank 12. This blank 12 has the center portion 14 with three sides 14, 14, 14, and the opposed surfaces, namely image receiving surface 13 and the opposed back surface 15 (shown in FIG. 4C).

A foldable extension 16, 16, 16, 16, respectively extends from each side 14, 14, 14, 14, of the center portion 14. The foldable extensions 16, 16, 16, may be scored with fold lines 18 that are meant to guide the folding of the foldable extensions 16, 16, 16, 16, toward the back surface 15. In an example, each foldable extension 16, 16, 16, has four fold lines 18 defining four respective folds 1, 2, 3, 4. In this example, each foldable extension 16, 16, 16, is foldable four times, once on each scored fold line 18. In other examples, it is to be understood that more than four fold lines 18 may be included on any foldable extension 16, 16, 16, 16, so that the foldable extension 16, 16, 16, is foldable more than four times.

In this example, the outermost fold line 18 defining the fold 4 and part of the fold 3 also includes a tab fold line 18. The tab fold line 18 may be scored so that when the folds 4 are folded, a tab 32 disconnects (either automatically or with application of a small force) along the tab fold line 18. The tab 32 can then be folded toward and secured to the surface 15 (see FIG. 4C). While not shown in all of the examples, it is to be understood that the tab fold lines 18 and 32 may be used in any of the blanks (e.g., 12, 12, 12, 12) and three-dimensional supporting frames (e.g., 10 and those formed from the blanks in FIGS. 5 and 6) disclosed herein.

As illustrated in FIGS. 4A and 4B, the adhesive 20 is applied to the center portion 14 and the folds 1 and 2 of each foldable extension 16, 16, 16, 16. The application of adhesive 20 in this manner will enable an image receiving medium 26 to be adhered to the image receiving surface 13 on the center portion 14 and on each of the folds 1 and 2. In this example, when the blank 12 having the image receiving medium 26 thereon is folded, the image receiving medium 26 will cover the outer perimeter wall (formed of folds 1) and the back wall (formed of folds 2) of the three-dimensional supporting frame 10, which is shown in FIG. 4C.

As also illustrated in FIGS. 4A and 4B, the adhesive 22 is applied to the folds 4 and to areas of the folds 3 that are within the tab fold lines 18. The adhesive 22 applied in this manner may be desirable to secure the folds 4 to the back surface 15 and to secure the punched-out tabs 32 to the back surface 15 after the blank 12, has been folded.

The foldable extensions 16, 16, 16, and the folds 1, 2, 3, 4 of the blank 12, may have any suitable shape that allows the folds 1, 2, 3, 4 of the respective foldable extension 16, 16, 16, to be folded toward the back surface 15 to form a three-dimensional frame portion (see reference numerals 30, 30, 30, in FIG. 4C). In the example shown in FIGS. 4A and 4C, the foldable extensions 16, 16, 16, are angled so that when folded, the abutting frame portions 30, 30, 30, form corners of the triangular three-dimensional supporting frame 10.

To construct the three-dimensional supporting frame 10, fold 1 of each of the extensions 16, 16, 16, is folded inward (i.e., towards the surface 15). The fold 1 of a respective extension 16, or 16, or 16, forms an outer wall of the respective frame portion 30, 30, 30. All together, the folds 1 form the perimeter wall of the three-dimensional supporting frame 10, Fold 2 of each of the extensions 16, 16, 16, is folded inward (i.e., towards the surface 15). The fold 2 of a respective extension 16, or 16, or 16, forms a back wall of the respective frame portion 30, 30, 30. All together, the folds 2 form the back wall of the three-dimensional supporting frame 10. Fold 3 of each of the extensions 16, 16, 16, is then folded inward (i.e., towards the surface 15). The fold 3 of a respective extension 16, or 16, or 16, forms an inner wall of the respective frame portion 30, 30, or 30. All together, these folds 3 form the inner perimeter wall of the three-dimensional supporting frame 10. Finally, fold 4 of each of the extensions 16, 16, 16, is then folded inward (i.e., towards the surface 15). When fold 4 is folded, the tab fold line 18 may be punched out to detach the tab 32 along the tab fold line 18. The folds 4 and the tab 32 are adhered via adhesive 22 to the surface 15 at the center portion 14 of the blank 12.

It is to be understood that any release liners that may be present on the adhesive 20 may be removed prior to adhering an image receiving medium to the adhesive 20. Furthermore, any release liners that may be present on the adhesive 22 may be removed prior to adhering the folds 4 and tabs 32 to the back surface 15.

FIGS. 5 and 6 depict different blanks 12c and 12d that may be used to form different shaped three-dimensional supporting frames. Each of these blanks 12c and 12d includes a center portion 14, image receiving surface 13 and back surface 15 (which is not visible in these figures because they are front views), and foldable extensions (e.g., 16d, 16d, 16d, 16d, in FIGS. 5 and 16d, 16d, 16d, 16d, in FIG. 6). The foldable extensions include fold lines 18 (with or without tab fold lines 18) and four folds 1, 2, 3, 4.

As illustrated in FIGS. 5 and 6, the adhesives 20 and 22 are applied to the image receiving surface 13 of the blanks 12c and 12d in desirable areas so that i) an image receiving medium 26 may be adhered to the blank 12c and 12d (via adhesive 20), and ii) the folds 4, and in some instances tabs 32, may be secured to the back surface 15 (via adhesive 22).
Specifically in FIG. 5, adhesive 20 is applied to the center portion 14 on surface 13, and adhesive 22 is applied to the fold 4 and the portion of fold 3 within the tab fold lines 18 on surface 13. Specifically in FIG. 6, the adhesive 20 is applied to the center portion 14 and the folds 1 on surface 13, and adhesive 22 is applied to the folds 4. In each of these figures, the speckles are again used to illustrate adhesive 20 and the triangles and squiggly lines are again used to illustrate adhesive 22.

FIG. 5 depicts a circular shaped blank 12a that when folded forms a circular shaped three-dimensional supporting frame (not shown). FIG. 6 depicts a hexagon shaped blank 12b that when folded forms a hexagon shaped three-dimensional supporting frame (also not shown). While a hexagon is shown, it is to be understood that the blank 12b may be any desirable polygon. The folding of these blanks 12a, 12b may be accomplished in the manner previously described herein where each fold 1, 2, 3, 4 is folded towards the back surface 15 to form frame portions that abut one another. In FIG. 5, four frame portions will be formed that abut one another to create the circular three-dimensional supporting frame. In FIG. 6, six frame portions will be formed that abut one another to create the hexagon shaped three-dimensional supporting frame.

It is to be understood that the ranges provided herein include the stated range and any value or sub-range within the stated range. For example, a range from about 12 µm to about 60 µm should be interpreted to include not only the explicitly recited limits of about 12 µm to about 60 µm, but also to include individual values, such as 15 µm, 45 µm, etc., and sub-ranges, such as from about 15 µm to about 50 µm, from about 20 µm to about 30 µm, etc. Furthermore, when “about” is utilized to describe a value, this is meant to encompass minor variations (up to ±10%) from the stated value.

In describing and claiming the examples disclosed herein, the singular forms “a”, “an”, and “the” include plural referents unless the context clearly dictates otherwise.

While several examples have been described in detail, it will be apparent to those skilled in the art that the disclosed examples may be modified. Therefore, the foregoing description is to be considered non-limiting.

What is claimed is:

1. A three-dimensional supporting frame, comprising:
   a. a blank, including:
      an image receiving surface;
      a back surface opposed to the image receiving surface;
      a center portion defining a perimeter; and
      at least three foldable extensions extending from the perimeter, each of the foldable extensions including no less than four folds to be folded toward the back surface to form the three-dimensional supporting frame;
   an unfilled adhesive positioned on the image receiving surface at least at the center portion; and
   a filled adhesive positioned on the image receiving surface at each of the folds that is furthest from the perimeter.

2. The three-dimensional supporting frame as defined in claim 1 wherein the filled adhesive includes:
   a. a polymeric material;
   b. a filler; and
   c. a surface treatment agent.

3. The three-dimensional supporting frame as defined in claim 2 wherein the surface treatment agent is a compound of the following formula:

   \( \text{RO}_2 \text{SiR} = \text{R}^n \)

   wherein:
   \( \text{RO} \) is hydrolysable in a neutral environment or an acidic environment and includes at least one oxygen atom;
   \( \text{R}^n \) is chosen from alkyl groups, aromatic groups, and heteroaromatic groups; and
   \( \text{R}^n \) is a group that can be converted into a cationic functional group.

4. The three-dimensional supporting frame as defined in claim 3 wherein:
   \( \text{RO} \) is chosen from a methoxy group, an ethoxy group, and an acetoxy group;
   \( \text{R}^n \) is chosen from a carboxamide group, a primary amine group, a secondary amine group, a tertiary amine group, and a pyridine group.

5. The three-dimensional supporting frame as defined in claim 2 wherein the polymeric material is chosen from a polycarbonate, an elastic hydrocarbon polymer, and silicone, the polymeric material being a linear molecule having a weight average molecular weight ranging from about 200,000 to about 800,000 to about 350,000, or being a branched or cross-linked molecules having a weight average molecular weight ranging from about 300,000 to about 1,500,000.

6. The three-dimensional supporting frame as defined in claim 2 wherein the surface treatment agent is a compound of the following formula:

   \( \text{RO}_2 \text{SiR} = \text{R}^n \)

   wherein:
   \( \text{RO} \) is hydrolysable in a neutral environment or an acidic environment and includes at least one oxygen atom;
   \( \text{R}^n \) is chosen from alkyl groups, aromatic groups, and heteroaromatic groups; and
   \( \text{R}^n \) is a group that can be converted into a cationic functional group.

7. The three-dimensional supporting frame as defined in claim 2 wherein the polymeric material is chosen from a polycarbonate, an elastic hydrocarbon polymer, and silicone, the polymeric material being a linear molecule having a weight average molecular weight ranging from about 200,000 to about 800,000 to about 350,000, or being a branched or cross-linked molecules having a weight average molecular weight ranging from about 300,000 to about 1,500,000.

8. The three-dimensional supporting frame as defined in claim 1 wherein the unfilled adhesive includes a polymeric material chosen from a polycarbonate, an elastic hydrocarbon polymer, and silicone, the polymeric material being a linear molecule having a weight average molecular weight ranging from about 200,000 to about 800,000 to about 350,000, or being a branched or cross-linked molecules having a weight average molecular weight ranging from about 300,000 to about 1,500,000.

9. The three-dimensional supporting frame as defined in claim 1 wherein the unfilled adhesive forms a bond line having a thickness ranging from about 35 µm to about 185 µm, and wherein the unfilled adhesive forms a bond line having a thickness ranging from about 12 µm to about 60 µm.

10. The three-dimensional supporting frame as defined in claim 1, further comprising a release liner positioned on each of the filled adhesive and the unfilled adhesive.

11. An art canvas, comprising:
    a. a blank, including:
       an image receiving surface;
       a back surface opposed to the image receiving surface;
       a center portion defining a perimeter; and
       at least three foldable extensions extending from the perimeter, each of the foldable extensions including no less than four folds that are folded toward the back surface; and
    a filled adhesive adhering respective portions of the back surface and each of the folds that is furthest from the perimeter;
an image receiving medium having an image printed thereon; and
an unfilled adhesive adhering the image on the image receiving surface at least at the center portion.

12. The art canvas as defined in claim 11 wherein the unfilled adhesive adheres the image on the image receiving surface at each of the folds that is closest to the perimeter.

13. The art canvas as defined in claim 11 wherein the filled adhesive includes:
   a polymeric material;
   a filler; and
   a surface treatment agent.

14. The art canvas as defined in claim 13 wherein:
   the filler is an inorganic particle chosen from ground calcium carbonate, precipitated calcium carbonate, titanium dioxide, kaolin clay, silica, silicates, alumina trihydrate, and mixtures thereof; an organic particle chosen from polystyrene, copolymers of polystyrene, polymethacrylate, copolymers of polymethacrylate, polyolefins, copolymers of polyolefins, wax, paraffin, and mixtures thereof; or combinations of the inorganic particle and the organic particle; and
   the surface treatment agent is a compound of the following formula:
   $\text{RO}_x \text{SiR}^2 \equiv \text{R}^2$

   where:
   RO is hydrolysable in a neutral environment or an acidic environment and includes at least one oxygen atom;
   R' is chosen from alkyl groups, aromatic groups, and heteroaromatic groups; and
   R'' is a group that can be converted into a cationic functional group.

15. The art canvas as defined in claim 11 wherein the image receiving medium is a digital inkjet image receiving medium.

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