a roll-to-roll process, but can be imprinted with a discrete mold, making a seamless, continuously patterned roller mold unnecessary.

Furthermore, since there are rotating parts involved in all roll-to-roll processing, there may be wear at joints and between rotating parts. One joint of particular concern are rotary joints used in core clamps where the mating faces are commonly composed of silicon carbide or tungsten carbide. These mating faces usually need to be lapped and polished so that they can form a mechanical seal when the two faces mate. However, these mating faces abrade against each other and may thus eventually wear off, causing a lubricant leak. Another problem with the abrasion is that it can generate particles, which can contaminate the lubricant or the external cleanroom environment. Contact sliding may also have speed limitations over which heat becomes intolerable and may greatly increase the wear rate.

Thus, there exists a need to provide an imprinting apparatus and method that seeks to address at least some of the above problems.

SUMMARY

As disclosed herein~~In accordance with a first aspect of the present invention~~, there is provided an imprinting apparatus comprising:

releasing means for releasing a feed material;

an imprint drum comprising a rotatable inner member, and an outer member releasably mounted to the inner member and configured to engage with a first surface of the feed material for forming a plurality of structures adjacent to said first surface; and

collecting means for collecting the feed material together with the formed structures;

wherein the outer member has an engagement surface capable of accommodating at least one sheet mold, the at least one sheet mold engaging with the first surface of the feed material for forming the respective structures.

In accordance with a first aspect, there is provided an imprinting apparatus comprising:

releasing means for releasing a feed material having a first surface and a second surface;

peeling means for removing a protective layer from at least one of the first surface and the second surface of the feed material;

an imprint drum comprising a rotatable inner member, and an outer member releasably mounted to the inner member and configured to engage with the first surface of the feed material for forming a plurality of structures adjacent to said first surface; and

collecting means for collecting the feed material together with the formed structures;

wherein the outer member has an engagement surface capable of accommodating at least one sheet mold, the at least one sheet mold engaging with the first surface of the feed material for forming the respective structures.

The engagement surface may have a plurality of sheet molds attached thereto, and each of the plurality of sheet molds may have respective feature resolution and design.

As disclosed herein~~In accordance with a second aspect of the present invention~~, there is provided an imprinting method comprising the step of:

providing an imprint drum comprising a rotatable inner member, and an outer member releasably mounted to the inner member, wherein the outer member has an engagement surface capable of accommodating at least one sheet mold;

releasing a feed material;

engaging the at least one sheet mold with a first surface of the feed material for forming a plurality of respective structures adjacent to said first surface; and

collecting the feed material together with the formed structures.

In accordance with a second aspect, there is provided an imprinting method comprising the step of:

providing an imprint drum comprising a rotatable inner member, and an outer member releasably mounted to the inner member, wherein the outer member has an engagement surface capable of accommodating at least one sheet mold;

releasing a feed material having a first surface and a second surface;

removing a protective layer from at least one of the first surface and the second surface of the feed material;

engaging the at least one sheet mold with the first surface of the feed material for forming a plurality of respective structures adjacent to said first surface; and

collecting the feed material together with the formed structures.

As disclosed herein~~In accordance with a third aspect of the present invention~~, there is provided a method for fabricating an imprint drum for an imprinting apparatus, the method comprising the steps of:

providing an outer member having an engagement surface capable of accommodating at least one sheet mold, the at least one sheet mold being configured to engage with a first surface of a feed material for forming respective structures; and

mounting the outer member to a rotatable inner member.

In accordance with a third aspect, there is provided a method for fabricating an imprint drum for an imprinting apparatus, the method comprising the steps of:

providing an outer member having an engagement surface comprising at least one slot for receiving at least one detachable part capable of accommodating at least one sheet mold, the at least one sheet mold being configured to engage with a first surface of a feed material comprising a thermoplastic polymer for forming respective structures;

mounting the outer member to a rotatable inner member; and

installing a heating source in the at least one detachable part for heating the at least one sheet mold when present, to a temperature above a glass transition temperature of the thermoplastic polymer.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will be better understood and readily apparent to one of ordinary skill in the art from the following written description, by way of example only, and in conjunction with the drawings, in which:

Figure 1a shows a schematic diagram illustrating a UV roll-to-roll nanoimprinting system according to the prior art.

configured to imprint the respective structures directly onto the thermoplastic polymer.

15. The apparatus as claimed in claim 14, further comprising a heating source disposed in the inner member of the imprint drum for heating the at least one sheet mold to a temperature above a glass transition temperature of the thermoplastic polymer.

16. The apparatus as claimed in claim 14 when dependent on claim 2, further comprising a heating source disposed in each detachable part for heating the respective sheet mold mounted thereon to a temperature above a glass transition temperature of the thermoplastic polymer.

17. The apparatus as claimed in any one of the preceding claims, wherein the formed structures are micro-scale or nano-scale structures.

18. The apparatus as claimed in any one of the preceding claims, wherein the at least one sheet mold is fabricated using a material from a group consisting of nickel, NiCo (nickel, cobalt alloy), fluoropolymers and plastics.

19. The apparatus as claimed in any one of claims 1 to 17~~19~~, wherein the at least one sheet mold comprises a hybrid mold having a hard coating layer on top of a conformal backing layer.

20. The apparatus as claimed in any one of the preceding claims, wherein the engagement surface has a plurality of sheet molds attached thereto, and wherein each of the plurality of sheet molds has respective feature resolution and design.

21. An imprinting method comprising the step of:

providing an imprint drum comprising a rotatable inner member, and an outer member releasably mounted to the inner member, wherein the outer member has an engagement surface capable of accommodating at least one sheet mold;

releasing a feed material having a first surface and a second surface;

removing a protective layer from at least one of the first surface and the second surface of the feed material;