METHOD AND APPARATUS FOR FORMING ARTICLES WITH NON-UNIFORMLY PATTERNED COATINGS

TECHNICAL FIELD

[0001] The present disclosure relates generally to the application of coatings to substrates, and more particularly to the application of non-uniform patterned coatings to flexible substrates.

BACKGROUND

[0002] The fabrication of numerous commercial products includes the step of applying a coating to a substrate in the form of a sheet or a web of indefinite length. For some applications it is desirable to have an overall uniform coating on the substrate, while in others it is desirable to apply a non-uniform coating in the form of, e.g., a multiplicity of stripes. The non-uniform coating may be applied directly to the substrate or to an intermediate surface with subsequent transfer to the substrate, or may be applied superimposed over an earlier uniform coating on the substrate. For example, the use of needle tubes to apply stripes of a coating material to a coating roll has been described, for example in Maier, PCT Patent Publication WO2011/087657.

SUMMARY

[0003] The present disclosure describes a method of applying a coating material onto a substrate, including providing a first distribution manifold having a cavity and a first multiplicity of dispensing outlets in fluid communication with the cavity, providing a second distribution manifold having a cavity and a second multiplicity of dispensing outlets in fluid communication with the cavity, creating relative motion between a substrate and the dispensing outlets in a first direction, dispensing a first coating material from the first dispensing outlets while maintaining the relative motion and simultaneously translating the plurality of dispensing outlets in a second direction non-parallel to the first direction, and dispensing a second coating material from the second dispensing outlets while maintaining the relative motion and simultaneously translating the plurality of dispensing outlets in a second direction non-parallel to the first direction.

[0003a] In one aspect, the present disclosure relates to a method of applying a coating material to a substrate, comprising: providing a first distribution manifold having a cavity and a first plurality of dispensing outlets in fluid communication with the cavity; providing a second distribution manifold having a cavity and a second plurality of dispensing outlets in fluid communication with the cavity; and creating relative motion between a substrate and the dispensing outlets in a first direction; dispensing a first coating material from the first dispensing outlets onto the substrate while maintaining the relative motion, and simultaneously translating the plurality of dispensing outlets in a second direction non-parallel to the first direction; and dispensing a second coating material from the second dispensing outlets onto the substrate while maintaining the relative motion, and simultaneously translating the plurality of dispensing outlets in a second direction non-parallel to the first direction.

[0004] The present disclosure describes a method of applying a coating material to a substrate, including providing a first distribution manifold having a cavity and a first multiplicity of dispensing outlets in fluid communication with the cavity, creating relative motion between a substrate and the dispensing outlets in a first direction, dispensing a first coating material from the first dispensing outlets onto the substrate while maintaining the relative motion and simultaneously translating the plurality of dispensing outlets in a second direction non-parallel

to the first direction, and while maintaining the relative motion, translating the plurality of dispensing outlets in a third direction non-parallel to the first and second directions.

[0004a] In a second aspect, the present disclosure relates to a method of applying a coating material to a substrate, comprising: providing a first distribution manifold having a cavity and a first plurality of dispensing outlets in fluid communication with the cavity; creating relative motion between a substrate and the dispensing outlets in a first direction; dispensing a first coating material from the first dispensing outlets onto the substrate while maintaining the relative motion and simultaneously translating the plurality of dispensing outlets in a second direction non-parallel to the first direction, and translating the plurality of dispensing outlets in a third direction non-parallel to the first and second directions.

[0005] In some exemplary embodiments of the foregoing method, the second plurality of dispensing outlets is interleaved with the first plurality of dispensing outlets. In these or other embodiments, the first dispensing outlets are translated in a third direction non-parallel to the first direction and non-parallel to the second direction while dispensing coating material from the first dispensing outlets. In some of the embodiments where the first dispensing outlets are translated in a third direction, the second dispensing outlets are translated in a third direction non-parallel to the first direction and non-parallel to the second direction while dispensing coating material from the second dispensing outlets. In some of these embodiments, the second and third directions are substantially orthogonal to each other.

[0006] In some embodiments, the first direction is a machine direction, and the second direction is a cross direction. In some of these embodiments, the third direction is substantially orthogonal to a major surface of the substrate.

[0007] In some exemplary embodiments of the foregoing method, the substrate has a non-uniform surface and the translation in the third direction keeps the first dispensing outlets at a substantially constant height above the non-uniform surface as the substrate moves past the first dispensing outlets. In these or other embodiments, the translation in the second and third directions causes the first coating material to be dispensed onto the substrate in the form of a plurality of ellipses, arcs, polygons, Lissajous figures, or a combination thereof. In some of the embodiments where the first coating material is dispensed onto the substrate in the form of a plurality of ellipses, the plurality of ellipses are a plurality of circles. In some of these embodiments, the polygons have between 3 and 12 sides.

[0008] In some convenient embodiments, the distribution manifold may be separated into a manifold chamber containing the cavity, and a removable cartridge having the plurality of needle tubes. In some embodiments, at least one of the first plurality of dispensing outlets or the second plurality of dispensing outlets comprises a plurality of hollow needle tubes. In some of these latter embodiments, the hollow needle tubes are flexible. In some of such embodiments, wherein the flexible hollow needle tubes comprise metal, thermoplastic polymer, thermoset polymer, fused silica, or a combination thereof.

[0009] In some convenient embodiments, the coating material applied to the substrate forms a single layer pattern. In some convenient embodiments, the coating material applied to the substrate forms a dual layer pattern. In some embodiments, the first and second coating materials are different materials.