[0005] In many instances, it is desirable to seal the retroreflective sheeting and thereby to protect the optical elements (*e.g.*, cube corner elements and lenslets) from environmental degradation. Inclusion of a sealing layer in the sheeting prevents or limits entry of soil or moisture into the sheeting. Some exemplary methods of applying of a sealing layer are described in U.S. Patent Nos. 7,329,447; 7,611,251; 5,784,197; 4,025,159 (disclosing use of electron beam radiation); 5,706,132 (use of thermal bonding or radio frequency welding); PCT Publication WO 2011/152977 (describing multi-layer sealing films for prismatic retroreflective sheeting); and. 6,224,792 (hermetic encapsulation by the sealing layer).

[0006] After the sealing process is complete, the sealed back side is then coated with adhesive. Afterwards, a release liner is placed over the adhesive coating. In some instances, the adhesive is coated on a release liner, and the release liner is then laminated to the backside of the retroreflective sheeting.

Summary

[0007] The inventors of the present disclosure recognized that the existing method of sealing, adhesive coating, and release liner coating retroreflective sheeting requires numerous steps. The inventors also recognized that manufacturing efficiency and cost-saving could be achieved by reducing the number of separate steps in manufacturing these articles. To address these problems, the inventors of the present disclosure invented various processes described herein that eliminate the separate adhesive lamination step in making prismatic or lenslet retroreflective articles. At least some of these processes enable direct lamination of a seal film with adhesive (and optionally a release liner) to retroreflective articles in a single step.

[0008] Additionally, the inventors of the present disclosure recognized that the existing methods of sealing prismatic and lenslet retroreflective sheeting create air bubbles between the adhesive and the substrate to which the retroreflective sheeting is attached. The inventors of the present application recognized that creating a retroreflective sheeting with the ability to bleed or remove trapped gas or air bubbles could improve the overall performance (*e.g.*, durability, appearance under diffuse light, etc) of the sheeting. The inventors of the present disclosure recognized that one method to create a retroreflective sheeting with air bleed properties involves the inclusion of a multilayer film (including a sealing layer and an adhesive and optionally a release liner) through which seal legs and/or channels are present.

[0009] ~~Some embodiments~~A first aspect of the present disclosure relate to a retroreflective article, comprising a plurality of microreplicated retroreflective elements that are at least one of (a) prismatic elements or (b) lenslets; and a multilayer film adjacent to the microreplicated retroreflective elements and comprising a polymeric sealing layer and an adhesive layer; and seal legs extending through all layers of the multilayer film~~.~~; channels depressed in at least a portion of the multilayer film at the seal legs.

[0010] In some embodiments, the prismatic elements are at least one of truncated cube corner elements, pg cube corner elements, and full cube corner elements. In some embodiments, the microreplicated retroreflective elements are adjacent to at least one of a land layer or a body layer. In some embodiments,

the seal legs extend between the multilayer film and at least one of the microreplicated retroreflective elements, the land layer, or the body layer. ~~In some embodiments~~Preferably, the prismatic elements include a thermoplastic polymer. ~~In some embodiments~~Preferably, the thermoplastic polymer is at least one of an acrylic polymer, a polycarbonate, a polyester, a polyimide, a fluoropolymer, a polyamide, a polyetherketone; a poly(etherimide); a polyolefin; a poly(phenylene ether); a poly(styrene); a styrene copolymer; a silicone modified polymer; a cellulosic polymer; a fluorine modified polymer; and mixtures of the above polymers. Some embodiments further include an air interface between at least some of the microreplicated retroreflective elements and the multilayer film.

[0011] Some embodiments further include a release liner layer adjacent to the adhesive layer. ~~In some embodiments~~Preferably, the release liner is polymeric. In some embodiments, the release liner is comprised of two layers, a release layer facing the adhesive layer and an outer layer having a composition to reduce blocking. In some embodiments, the release liner comprises a release layer comprised of very low density polyethylene, and an outer layer comprised of a polyethylene that is not very low density polyethylene. ~~In some embodiments~~Preferably, the outer layer includes at least one of polypropylene, polyethylene, or polyethylene terephthalate.

[0012] In some embodiments, the polymeric sealing layer includes at least one of a thermoplastic polymer, a heat activated polymer, a polymer composition curable by ultraviolet radiation, and a polymer composition curable by ionizing radiation. ~~In some embodiments~~Preferably, the polymeric sealing layer includes a thermoplastic composition comprising at least 50 weight percent reaction products of an alkylene monomer and reaction products of at least one non-acidic polar monomer, and the thermoplastic composition comprises a polyalkylene modified by an acid, an anhydride, carbon monoxide or a combination thereof.

[0013] In some embodiments, the microreplicated retroreflective elements are coated with a specular reflective coating.

[0014] ~~Other embodiments~~ A second aspect relates to a process of making ~~a~~the retroreflective article as defined in the first aspect, comprising: laminating a multilayer film adjacent to a plurality of microreplicated retroreflective elements and thereby forming a plurality of seal legs that extend through all layers of the multilayer film; and the channels depressed in at least a portion of the multilayer film at the seal legs. ~~wherein~~Preferably the multilayer film comprises a polymeric sealing layer and an adhesive layer; and wherein the microreplicated retroreflective elements comprise at least one of prismatic elements and lenslets.

[0015] In some embodiments, laminating the multilayer film includes bonding the multilayer film to the plurality of microreplicated retroreflective elements by at least one of ultrasonic, radio frequency welding, thermal bonding, ultraviolet radiation, and electron beam radiation. Some embodiments further comprise using solution casting, extrusion casting, blown film extrusion, or any combination thereof to form the multilayer film. ~~In some embodiments~~Preferably, extrusion casting involves coextrusion casting. ~~In some embodiments~~Preferably, blown film extrusion involves blown film coextrusion.

[0016] ~~In some embodiments~~Preferably, the prismatic elements are at least one of truncated cube corner elements, pg cube corner elements, and full cube corner elements. ~~In some embodiments~~Preferably, the microreplicated retroreflective elements are adjacent to at least one of a land layer or a body layer. ~~In some embodiments~~Preferably, the seal legs extend between the multilayer film and at least one of the microreplicated retroreflective elements, the land layer, or the body layer. ~~In some embodiments~~Preferably, the microreplicated retroreflective elements include a thermoplastic polymer. ~~In some embodiments~~Preferably, the thermoplastic polymer is at least one of an acrylic polymer, a polycarbonate, a polyester, a polyimide, a fluoropolymer, a polyamide, a polyetherketone; a poly(etherimide); a polyolefin; a poly(phenylene ether); a poly(styrene); a styrene copolymer; a silicone modified polymer; a cellulosic polymer; a fluorine modified polymer; and mixtures of the above polymers. ~~Some embodiments~~Preferably, the process involves laminating the multilayer film adjacent to the plurality of microreplicated retroreflective elements to form an air interface between at least some of the microreplicated retroreflective elements and the multilayer film.

[0017] ~~In some embodiments~~Preferably, the multilayer film further comprises a release liner layer adjacent to the adhesive layer. ~~In some embodiments~~Preferably, the release liner layer is polymeric. ~~In some embodiments~~Preferably, the release liner layer is comprised of two layers, a release layer facing the adhesive layer and an outer layer having a composition to reduce blocking. ~~In some embodiments~~Preferably, the release liner layer comprises a release layer comprised of very low density polyethylene, and an outer layer comprised of a polyethylene that is not very low density polyethylene. ~~In some embodiments~~Preferably, the outer layer includes at least one of polypropylene, polyethylene, or polyethylene terephthalate.

[0018] ~~In some embodiments~~Preferbaly, the polymeric sealing layer includes at least one of a thermoplastic polymer, a heat activated polymer, a polymer composition curable by ultraviolet radiation, or a polymer composition curable by ionizing radiation. ~~In some embodiments~~Preferably, the polymeric sealing layer includes a thermoplastic composition comprising at least 50 weight percent reaction products of an alkylene monomer and reaction products of at least one non-acidic polar monomer, and the thermoplastic composition comprises a polyalkylene modified by an acid, an anhydride, carbon monoxide, or a combination thereof.

[0019] ~~In some embodiments~~Preferably, the microreplicated retroreflective elements are coated with a specular reflective coating.

[0020] Some embodiments further involve co-extruding the sealing layer and adhesive layer in a single step to form the multilayer film.

[0021] Other features and advantages of the present application are described or set forth in the following detailed specification that is to be considered together with the accompanying drawings.

Brief Description of Drawings

[0022] The disclosure may be more completely understood in consideration of the following detailed description of various embodiments of the disclosure in connection with the accompanying drawings.