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(54) **Titre :** PELLICULE D'EMBALLAGE PERMEABLE AU DIOXYDE DE CARBONE GAZEUX  
(54) **Title:** CARBON DIOXIDE GAS PERMEABLE PACKAGING FILM

(57) **Abrégé/Abstract:**

A carbon dioxide permeable packaging film providing moisture barrier, sealability, and flex-crack resistance characteristics and is ideal for use in packaging of carbon dioxide respiring food products, such as Swiss cheese, to increase shelf life thereof.



## ABSTRACT

A carbon dioxide permeable packaging film providing moisture barrier, sealability, and flex-crack resistance characteristics and is ideal for use in packaging of carbon dioxide respiring food products, such as Swiss cheese, to increase shelf life thereof.

## CARBON DIOXIDE GAS PERMEABLE PACKAGING FILM

### BACKGROUND

Embodiments of the present inventive concept relate to packaging and, in particular, to a packaging film which is permeable to carbon dioxide gas and which has moderate oxygen gas barrier properties and high moisture characteristics. The packaging film of the present invention also has superior sealability and flex-crack resistance characteristics and is ideal for use with carbon dioxide respiring food products, such as Swiss cheese, to increase the shelf life thereof.

Flexible packaging, particularly for food, is subject to many demands. The packaging needs to be workable in such a way that the packaging material may be quickly placed around the item to be packaged using machinery. The packaging material must also be of such a quality that it adequately stores the product before the packaging is opened. In the case of food products, this typically means that the packaging materials provide an oxygen and moisture barrier to maintain freshness.

One commonly used structure in the marketplace for packaging carbon dioxide respiring products such as Swiss cheese is a laminated film having polyethylene terephthalate (PET), adhesive, oriented polypropylene, and ethylene vinyl acetate (EVA) layers. This structure, however, has poor flex crack resistance and oxygen gas barrier properties. Another commonly used structure is a laminated film having Biaxially-Oriented Nylon (BON), adhesive, oriented polypropylene, and EVA layers (see U.S. Patent No. 7,008,677). One drawback of this structure is its high stiffness and rigidity that causes creation of pin holes in sharp corners.

Accordingly, there is a continuing need for improved flexible packaging and a method of making the same that provides carbon dioxide breathability while also providing superior sealing and moisture barrier properties as well as excellent flex crack and puncture resistance.

## SUMMARY

The following brief summary is provided to indicate the nature of the subject matter disclosed herein. While certain aspects of the present inventive concept are described below, the summary is not intended to limit the scope of the present inventive concept. Embodiments of the present inventive concept provide a packaging film and method that does not suffer from the problems and limitations of conventional packaging such as those previously discussed.

In one aspect, a packaging film comprises a barrier layer having a first surface and a second surface opposite the first surface. The barrier layer comprises a coextruded multilayer structure having a moisture barrier core layer effective to limit the passage of moisture through the packaging film. An abuse layer is disposed on the first surface of the barrier layer and is effective to resist flex cracking of the packaging film and to control oxygen and carbon dioxide permeation. A sealant layer is disposed on the second surface of the barrier layer, the sealant layer configured to provide a hermetic seal at high packaging speeds upon being heat sealed with a like sealant layer of an aligned packaging film.

In another aspect, a method of manufacturing a moisture barrier packaging film comprises coextruding a multilayer barrier structure having a first surface and a second surface opposite the first surface, the multilayer barrier layer comprising a moisture barrier core layer. An abuse layer is attached to the first surface of the multilayer barrier structure and a sealant layer is formed on the second surface.

In yet a further aspect, a food package comprises opposing front and back panels of a polymer packaging film. A barrier layer of the polymer packaging film has a first surface and a second surface opposite the first surface. The barrier layer comprises a coextruded multilayer structure having a moisture barrier core layer effective to limit the passage of moisture through the packaging film. An abuse layer of the packaging film is disposed on the first surface of the barrier layer, the abuse layer being effective to resist flex cracking of the packaging film and to control oxygen and carbon dioxide permeation. A sealant layer of the packaging film is disposed on the second surface of the barrier layer, the sealant layer configured to provide a hermetic seal at high packaging speeds upon being heat

sealed with a like sealant layer of an aligned packaging film. A hermetic seal is provided between at least a portion of the front and back panels of the polymer packaging film.

Additional aspects, advantages, and utilities of the present inventive concept will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the present inventive concept.

### BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the present inventive concept are described in detail below with reference to the attached drawing figures, wherein:

FIG. 1 is a schematic illustrating a film with a layer structure, in accordance an exemplary embodiment of the present inventive concept.

The drawing figure does not limit the present inventive concept to the specific embodiments disclosed and described herein. The drawings are not necessarily to scale, emphasis instead being placed upon clearly illustrating the principles of the present inventive concept.

### DETAILED DESCRIPTION

Detailed embodiments of the present inventive concept are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention, which may be embodied in various forms. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present inventive concept in virtually any appropriately detailed structure. Further, the terms and phrases used herein are not intended to be limiting but rather to provide an understandable description of the present inventive concept.

The terms "a" or "an," as used herein, are defined as one or more than one. The term "another," as used herein, is defined as at least a second or more. The terms "including" and/or "having" as used herein, are defined as comprising (i.e., open transition). The term "coupled" or "operatively coupled," as used herein, is defined as indirectly or directly connected.

Referring to FIGURE 1, a packaging film **100** manufactured in accordance with embodiments of the preset inventive concept is illustrated. The packaging film **100** is configured to be utilized to package a food product **150** and may advantageously be used in connection with the packaging of Swiss cheese or other carbon dioxide gas respiring food product and is shown and described herein primarily by way of reference thereto. It is to be understood, however, that the packaging film **100** is equally useful for packaging other food products.

For some applications, such as for packaging Swiss cheese and others, a packaging film with superior sealability (i.e., the ability to obtain a hermetic seal at a high packaging speed), high barrier to moisture and good oxygen barrier properties (to increase the shelf life of the product **150**), respiring to carbon dioxide and excellent flex crack resistance (to eliminate creating pin holes during the packing process and during transportation) is required. In order to achieve all these requirements, the multilayer laminated film **100** in accordance with this disclosure was developed.

The multilayer film **100** comprises a first, abuse layer **110**, a second, adhesive layer **120**, a third, barrier layer **130**, and a fourth, sealant layer **140**. The structure of an exemplary embodiment of the packaging film **110** is as follows:

BON - Adhesive or Polyethylene - Polyethylene or Polyethylene Copolymer / HDPE /  
Polyethylene or Polyethylene Copolymer - Polyethylene Copolymer Sealant

wherein a "-" is used to indicate layers that are separately formed and attached and "/" is used to indicate layers that are coextruded with one another.

The first layer **110** comprises an abuse layer on the exterior side of the packaging film **100** which does not contact the food product **150**. The abuse layer **110** is preferably made of a biaxially oriented nylon film, preferably 36 to 80 gauge biaxially oriented nylon, which has been found to provide excellent flex crack resistance. The abuse layer **110** is permeable to carbon dioxide gas and has moderate oxygen barrier properties. In this manner, the thickness of the abuse layer **110** comprises at least a fraction of the thickness

of the packaging film **100** in its entirety. It is foreseen that the abuse layer **110** may be made of any like material without deviating from the scope of the present inventive concept.

The third layer **130** is a coextruded barrier film having a moisture barrier layer **133** in the core, which provides an excellent moisture barrier between the Swiss cheese or other food product **150** and the surrounding environment, thereby enhancing product shelf life. The third layer **130** has a thickness which is a fraction of the thickness of the packaging film **100** and provides a variety of advantages to the packaging film **100**, as discussed herein. Preferably, the third layer **130** has a thickness in the range of about 0.8 mil to about 2.0 mil.

The core **133** is preferably made of high density polyethylene (HDPE) with a density between 0.93 to 0.97 g/cm<sup>3</sup> and has a thickness of a fraction of the thickness of the packaging film **100** in its entirety. It is foreseen, however, that the middle layer **133** may be made of any HDPE or like material without deviating from the scope of the present inventive concept.

The coextruded barrier layer **130** further includes outer layers **131** and **132** on the opposite sides of the core **133**. The outer layers **131** and **132** adhere to the core layer **133** without the need to use tie layers between the coextruded layers.

The outermost layers **131** and **132** are disposed on the opposite side of the central core **133** and have a thickness which is a fraction of the thickness of the packaging film **100** in its entirety. In preferred embodiments, the outer core layers **131**, **132** comprise polyolefin or polyolefin copolymer, preferably polyethylene or polyethylene copolymer. It is foreseen, however, that the outer core layers **131**, **132** may be made of other like materials without deviating from the scope of the present inventive concept.

The core layer **133** may be extruded from a first extruder. The outer layers **131**, **132** may be extruded from a second and third extruders. The outer layers (**131**, **132**) of the barrier layer **130** may each be split into two layers and directed to either side of the HDPE core layer **133** layer by a feedblock device.

The coextruded barrier film layer **130** is laminated to the abuse layer **110** using an adhesive layer **120** disposed between the abuse layer **110** and the coextruded barrier layer **130**. In this manner, the barrier film layer **130** and the abuse layer **110** are adhered together. In the preferred embodiment, the adhesive layer **120** is polyethylene or polyurethane. It is

foreseen, however, that the adhesion layer **120** may be made of any other suitable adhesive layer without deviating from the scope of the present inventive concept.

The sealant layer (inner layer) **140** comprises a low seal initiation temperature ethylene copolymer such as ethylene vinyl acetate (EVA) and has a thickness of a fraction of the thickness of the packaging film **100** in its entirety. The thickness of the sealant layer **140** is preferably in the range of about 0.8 mil to 2.0 mil. The sealant layer is preferably a low seal initiation temperature ethylene copolymer, most preferably an ethylene copolymer having a comonomer content of 12% or higher and a melt flow index of about 20 g/in or higher. The sealant layer **140** directly abuts the coextruded barrier layer **130** and is adhered to the coextruded barrier layer **130** using an extrusion coating process. The multilayer structure **100** described herein has superior seal characteristics, permeable to carbon dioxide, moderate oxygen barrier properties, high barrier to moisture, and flex crack resistance.

The packaging film **100** according to the present disclosure provides an improved multilayer packaging over the prior art film structures for packing carbon dioxide respiring products such as Swiss having an oriented polypropylene barrier layer, such as the films described in U.S. Patent No. 7,008,677. The layers **110**, **130**, and **140** complement each other by supplementing weaker characteristics of the other. By using a BON abuse layer **110** in the presently disclosed structure, it has improved flex crack resistance and good oxygen barrier properties and also it is permeable to carbon dioxide. Replacing the prior art oriented polypropylene barrier layer a coextruded moisture barrier with HDPE in the core provides a softer structure without sacrificing moisture barrier properties. The sealant layer **140** has enhanced seal properties that are higher than that of the barrier layer **130**.

In this manner, the packaging film **100** of the present disclosure has carbon dioxide breathability, enhanced seal characteristics, moderate oxygen barrier properties, and excellent moisture barrier and flex-crack resistance characteristics. It has been discovered via testing of the packaging film **100** of the present inventive concept that such yields almost zero pin holes in flex crack testing. Thus, the packaging film **100** is particularly ideal for use with and to store the food product **150**, which may advantageously be Swiss cheese or other carbon dioxide respiring food products.

Although the present inventive concept has been described with reference to the preferred embodiments illustrated in the attached drawing figures, it is noted that equivalents may be employed and substitutions made herein without departing from the scope of the present inventive concept as recited in the claims.

**CLAIMS:**

1. A packaging film comprising:
  - a barrier layer having a first surface and a second surface opposite the first surface, said barrier layer comprising a coextruded multilayer structure having a moisture barrier core layer effective to limit passage of moisture through the packaging film;
  - an abuse layer disposed on the first surface of the barrier layer, said abuse layer effective to resist flex cracking of the packaging film and to control oxygen and carbon dioxide permeation; and
  - a sealant layer disposed on the second surface of the barrier layer, the sealant layer configured to provide a hermetic seal at high packing speed upon being heat sealed with a like sealant layer of an aligned packaging film.
2. The packaging film of claim 1, wherein the barrier layer comprises:
  - a first outer layer on a first side of the moisture barrier core layer and a second outer layer on a second side of the core layer opposite the first side of a middle barrier layer.
3. The packaging film of claim 2, wherein the first and second outer layers are selected from a polyolefin and polyolefin copolymer.
4. The packaging film of claim 3, wherein the first and second outer layers are selected from polyethylene or ethylene vinyl acetate.
5. The packaging film of claim 4, wherein the first and second outer layers are formed of polyethylene having a density in the range of from 0.90 to 0.94 g/cm<sup>3</sup>.
6. The packaging film of claim 1, wherein the barrier layer has a thickness of 0.8 mil to 2.0 mil.

7. The packaging film of claim 1, wherein the moisture barrier core layer contains high density polyethylene (HDPE) having a density in the range of from 0.93 to 0.97 g/cm<sup>3</sup>.

8. The packaging film of claim 1, wherein the abuse layer contains biaxially oriented nylon.

9. The packaging film of claim 1, further comprising:  
an adhesive layer disposed between the abuse layer and the barrier layer.

10. The packaging film of claim 9, wherein the adhesive layer is selected from polyethylene and polyurethane.

11. The packaging film of claim 1, wherein the sealant layer is a low seal initiation temperature ethylene copolymer having a comonomer content of about 12% or higher and a melt flow index of about 20 g/in or higher.

12. The packaging film of claim 1, wherein the sealant layer is an ethylene vinyl acetate (EVA).

13. A method of manufacturing a moisture barrier packaging film comprising the steps of:

coextruding a multilayer barrier structure having a first surface and a second surface opposite the first surface, said multilayer barrier layer comprising a moisture barrier core layer;

attaching an abuse layer to the first surface of the multilayer barrier structure;

and

forming a sealant layer on the second surface.

14. The method of claim 13, wherein the abuse layer is attached to the first surface using an adhesive.

15. The method of claim 13, wherein sealant layer is formed on the second surface using an extrusion coating process.

16. The method of claim 13, wherein the multilayer barrier structure includes:

a first outer layer on a first side of the moisture barrier core layer and a second outer layer on a second side of the core layer opposite the first side of a middle barrier layer.

18. The method of claim 16, wherein each of the first and second outer layers is selected from the group consisting of polyethylene and polyethylene copolymers.

19. The method of claim 13, wherein the moisture barrier core layer contains high density polyethylene (HDPE).

20. The method of claim 13, wherein the abuse layer contains biaxially oriented nylon.

21. The method of claim 12, wherein the sealant layer is a low seal initiation temperature ethylene copolymer.

22. A food package, comprising:  
opposing front and back panels of a polymer packaging film;  
a barrier layer of the polymer packaging film having a first surface and a second surface opposite the first surface, said barrier layer comprising a coextruded multilayer structure having a moisture barrier core layer effective to limit passage of moisture through the packaging film;

an abuse layer of the packaging film disposed on the first surface of the barrier layer, said abuse layer effective to resist flex cracking of the packaging film and to control oxygen and carbon dioxide permeation;

a sealant layer of the packaging film disposed on the second surface of the barrier layer, the sealant layer configured to provide a hermetic seal upon being heat sealed with a like sealant layer of an aligned packaging film; and

a hermetic seal between at least a portion of the front and back panels of the polymer packaging film.

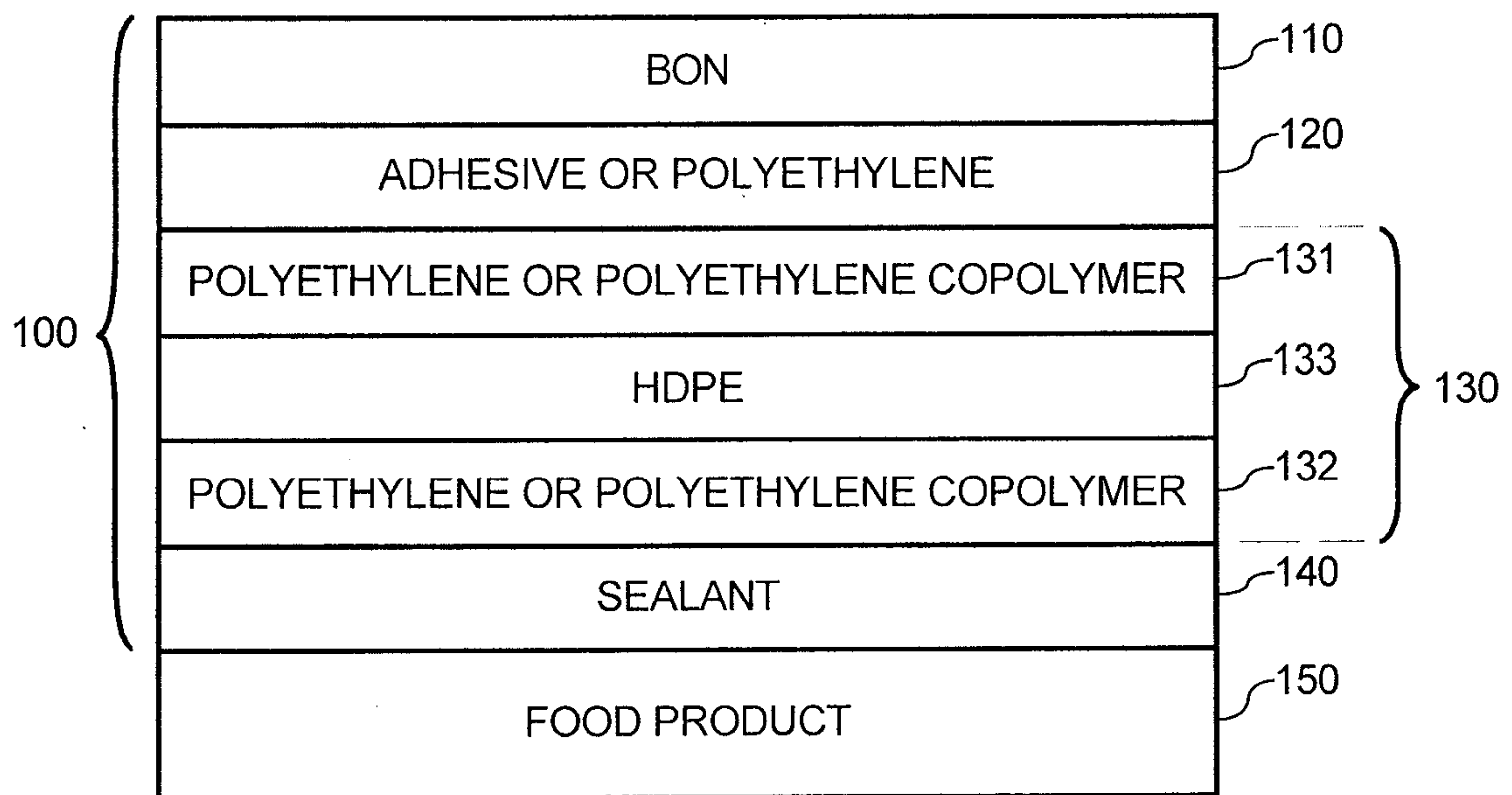


FIG. 1