hand tearability, conformability, etc. Accordingly, such films and the resultant tapes incorporating them as backing members have numerous advantageous uses. However, because the central opening within each modification zone passes completely through the film, such films are inherently permeable.

The need exists for impermeable films and articles incorporating such films (e.g., adhesive tapes) that exhibit good release properties (and thus impart good unwind performance to an adhesive tape made with such films), good conformability, and hand tearability with other desired mechanical properties.

Summary

Embodiments of this invention provide a family of films which may have surprisingly good hand tearability, good processability, water resistance, liquid impermeability, and conformability. Such films are particularly useful as, for example, protective films and backing films for adhesive tapes and sheets. Embodiments of the present invention provide such films, articles made with such films, and methods for making such films.

In brief summary, an article according to a first aspect of the invention comprises a principal film, wherein the principal film:

(a) comprises a first polymeric component comprising one or more polymers ; and

(b) has: (1) first and second major faces; (2) a land portion wherein the principal film is capable of thermally-induced elastic recovery; and (3) one or more modification zones. Each modification zone comprises a central portion and a rim portion surrounding the central portion and is surrounded by land portion, wherein the average thickness of each rim portion is greater than the average thickness of the land portion surrounding the modification zone, the average thickness of each central portion is less than the average thickness of the land portion surrounding the modification zone and is greater than zero. One or more segments of the principal film have a tear strength of less than 100 g_f/mil-thickness.

In brief summary, a method for forming the article of the first aspect comprises:

(a) providing a precursor member that is capable of thermally-induced elastic recovery and has first and second major faces;

(b) differentially heating at least one target zone of the precursor member above its relaxation temperature (T_r) while maintaining the temperature of the portion of the precursor member surrounding the modification zone at a temperature below its T_r so as to cause dimensional modification of the precursor member within the modification zone such that a portion of the film material in the target zone undergoes thermally-induced elastic recovery and forms a modification zone comprising a central portion surrounded by a rim portion wherein maximum thickness of the rim portion becomes relatively greater

and the relative thickness of the central portion decreases without opening from the first face to the second face and

(c) cooling the modification zone to below T_r thereby yielding a principal film having: (1) first and second major faces; (2) a land portion wherein the principal film is capable of thermally-induced elastic recovery; and (3) one or more modification zones comprising a central portion and a rim portion surrounding the central portion, the modification zone being surrounded by land portion, wherein the average thickness of each rim portion is greater than the average thickness of the land portion surrounding the modification zone, the average thickness of each central portion is less than the average thickness of the land portion surrounding the modification zone and is greater than zero.

There is also disclosed an adhesive tape comprising (a) a backing member having front and rear major faces wherein an article of the first aspect is the front major face of the backing member and (b) an adhesive layer comprising normally tacky, pressure sensitive adhesive on the rear major face of the backing member.

Brief Description of Drawing

The invention is further explained with reference to the attached drawing wherein:

Fig. 1 is a plan view of the first major face of an illustrative embodiment of a sheet of the invention;

Fig. 2 is a cross-sectional view of a portion of the sheet shown in Fig. 1;

Fig. 3A is a schematic cross-sectional view of a portion of an illustrative modification zone showing the impact of thermally-induced elastic recovery during differential heating in accordance with the method of the present invention;

Fig. 3B is a graphical illustration of the temperature profile within a corresponding precursor film of the invention during differential heating in accordance with the method of the invention;

Fig. 4 is a photograph of a cross section of a portion of a flame perforated film of the prior art;

Fig. 5 is a scanning electron microscope photograph of a portion of a flame perforated film of the prior art;

Fig. 6 is a photograph of a cross section of a modification zone of a film of the invention;

Fig. 7 is a scanning electron microscope photograph of a modification zone of a film of the invention;

Fig. 8 is a graph showing constrained elastic recovery stress in select films;

Fig. 9 is a perspective view of an illustrative embodiment of a roll of tape of the invention;

Fig. 10 is a cross-sectional view of a portion of the tape shown in Fig. 9; and

Figs. 11A and 11B are plan views of other illustrative embodiments of sheets of the invention.

These figures are not to scale and are intended to be merely illustrative and not limiting. Like reference numbers are used to indicate like members and features.

Detailed Description of Illustrative Embodiments

Key and Glossary

What is claimed is:

1. An article comprising a principal film, wherein:

(a) the principal film comprises a first polymeric component comprising one or more polymers; and

(b) the principal film has: (1) first and second major faces; (2) a land portion wherein the principal film is capable of thermally-induced elastic recovery; and (3) one or more modification zones, each modification zone comprising a central portion and a rim portion surrounding the central portion and being surrounded by land portion, wherein the average thickness of each rim portion is greater than the average thickness of the land portion surrounding the modification zone, the average thickness of each central portion is less than the average thickness of the land portion surrounding the modification zone and is greater than zero, and wherein one or more segments of the principal film have a tear strength of 100 g_f/mil-thickness or less.

2. The article of claim 1 wherein the average thickness of the land portion of the principal film is about 0.5 to about 3 mils (13 to 75 microns).

3. The article of claim 1 wherein the land portion of the principal film exhibits a shrinkage response of not more than 1% when evaluated according to ASTM D2732.

4. The article of claim 1 wherein the land portion of the principal film exhibits a shrinkage response of about 0.3 % or less when evaluated according to ASTM D2732 .

5. The article of claim 1 wherein one or more segments of the principal film have a tear strength of about 70 g_f/mil-thickness or less.

6. The article of claim 1 wherein one or more segments of the principal film have a tear strength of about 55 g_f/mil-thickness or less.

7. The article of claim 1 wherein the first polymeric component comprises one or more polyolefin polymers.

8. The article of claim 1 wherein the first polymeric component is selected from the group consisting of polyolefin, polyester, polystyrene, polyamide, or combinations thereof.

9. The article of claim 1 wherein the land portion of the principal film is biaxially oriented.

10. The article of claim 1 wherein that land portion of the principal film is uniaxially oriented.

32. The method of claim 29 wherein the differentially heating is carried out by applying infrared energy to the first major side of the precursor member while cooling portions of the second major side of the precursor member.

33. The method of claim 32 wherein the precursor member is supported on a chill roll having a dimpled surface during the differential heating.

34. The method of claim 29 wherein providing the precursor member comprises:

(a) providing the first polymeric component and the second polymeric component;

(b) blending the first polymeric component and the second polymeric component and forming a film having first and second major sides therefrom;

(c) orienting the thusly formed film in such a fashion that recoverable strain is induced to yield a precursor member capable of elastic recovery.