for the inner surfaces of the pharmaceutical package to shed glass particulates or "de-laminate" following exposure to pharmaceutical solutions.

[0005] In addition, use of glass in pharmaceutical packaging may also be limited by the mechanical performance of the glass. Specifically, the high processing speeds utilized in the manufacture and filling of glass pharmaceutical packages may result in mechanical damage on the surface of the package, such as abrasions, as the packages come into contact with processing equipment, handling equipment, and/or other packages. This mechanical damage significantly decreases the strength of the glass pharmaceutical package resulting in an increased likelihood that cracks will develop in the glass, potentially compromising the sterility of the pharmaceutical contained in the package or causing the complete failure of the package.

[0006] Accordingly, a need exists for alternative glass containers for use as pharmaceutical packages which exhibit a combination of at least two of improved resistance to delamination, increased strength, and/or damage tolerance.

SUMMARY

[0006a] In one aspect, there is proviced a glass container comprising:

a body formed from an aluminosilicate glass composition, the body having an inner surface, an outer surface and a wall thickness extending between the outer surface and the inner surface, wherein the body comprises a compressively stressed layer extending into the wall thickness from at least one of the outer surface and the inner surface; and

a lubricous coating positioned on at least a portion of the outer surface of the body, wherein the outer surface of the body with the lubricous coating has a coefficient of friction less than or equal to 0.7, wherein:

the lubricous coating is a tenacious organic coating comprising a polymer chemical composition and a coupling agent;

the lubricous coating has a mass loss of less than about 5% of its mass when heated from a temperature of 150 °C to 350 °C at a ramp rate of about 10 °C/minute; and the coefficient of friction is a maximum coefficient of friction measured relative to a second glass container in a vial-on-vial testing jig under a normal load of 30 N, the second glass container having a body formed from the aluminosilicate glass composition and comprising the lubricous coating on an at least a portion of the outer surface of a body of the second glass container and subjected to the same environmental conditions prior to measurement.

[0007] According to one example, a glass container may include a body formed from a Type I, Class B glass composition according to ASTM Standard E438-92. The body may have an inner surface, an outer surface and a wall thickness extending between the outer surface and the inner surface. The body may also include a compressively stressed layer extending into the wall thickness from at least one of the outer surface and the inner surface. A lubricous coating may be positioned on at least a portion of the outer surface of the body, wherein the outer surface of the body with the lubricous coating has a coefficient of friction less than or equal to 0.7.

[0007a] In another aspect, there is proviced a glass container comprising:

a body formed from an aluminosilicate glass composition, the body having a hydrolytic resistance of HGB2 or better according to ISO 719 and an inner surface, an outer surface and a wall thickness extending between the outer surface and the inner surface, wherein the body is ion-exchange strengthened such that the body comprises a compressively stressed layer extending into the wall thickness from at least one of the outer surface and the inner surface; and

a lubricous coating positioned on at least a portion of the outer surface of the body, wherein the portion of the outer surface of the body with the lubricous coating has a coefficient of friction less than or equal to 0.7, wherein:

the lubricious coating comprises a polymer chemical composition and a coupling agent;

the lubricous coating is a tenacious organic coating that is thermally stable at a temperature of at least about 260°C for 30 minutes; and

the coefficient of friction is a maximum coefficient of friction measured relative to a second glass container in a vial-on-vial testing jig under a normal load of 30 N, the second glass container having a body formed from the aluminosilicate glass composition and comprising the lubricous coating on an at least a portion of the outer surface of a body of the second glass container and subjected to the same environmental conditions prior to measurement.

[0008] According to another example, a glass container may include a body formed from a Type I, Class B glass composition according to ASTM Standard E438-92. The body may have a hydrolytic resistance of HGB2 or better according to ISO 719. The body may also have an inner surface, an outer surface and a wall thickness extending between the outer surface and the inner surface. The body may be ion-exchange

strengthened such that the body comprises a compressively stressed layer extending into the wall thickness from at least one of the outer surface and the inner surface. A lubricous coating may be positioned on a portion of at least one of the outer surface and the inner surface of the body, wherein the lubricous coating is thermally stable at a temperature of at least about 260°C for 30 minutes.

[0009] In yet another example, a glass container may include a body formed from a Type I, Class B glass composition according to ASTM Standard E438-92. The body may have a hydrolytic resistance of HGB2 or better according to ISO 719. The body may also have an inner surface, an outer surface and a wall thickness extending between the outer surface and the inner surface. A compressively stressed layer may extend into the wall thickness from at least one of the outer surface and the inner surface, the compressively stressed layer having a surface compressive stress greater than or equal to 150 MPa and a depth of layer greater than or equal to 25 μm. A lubricous coating may be positioned on a portion of at least one of the outer surface and the inner surface of the body, wherein the lubricous coating is thermally stable at a temperature of at least about 260°C for 30 minutes.

[0010] Additional features and advantages of the examples of the glass containers described herein will be set forth in the detailed description which follows, and in part will be readily apparent to those skilled in the art from that description or recognized by practicing the examples described herein, including the detailed description which follows, the claims, as well as the appended drawings.

[0011] It is to be understood that both the foregoing general description and the following detailed description describe various examples and are intended to provide an overview or framework for understanding the nature and character of the claimed subject matter. The accompanying drawings are included to provide a further understanding of the various examples, and are incorporated into and constitute a part of this specification. The drawings illustrate the various examples described herein, and together with the description serve to explain the principles and operations of the claimed subject matter.

Claims

1. A glass container comprising:

a body formed from an aluminosilicate glass composition, the body having an inner surface, an outer surface and a wall thickness extending between the outer surface and the inner surface, wherein the body comprises a compressively stressed layer extending into the wall thickness from at least one of the outer surface and the inner surface; and

a lubricous coating positioned on at least a portion of the outer surface of the body, wherein the outer surface of the body with the lubricous coating has a coefficient of friction less than or equal to 0.7, wherein:

the lubricous coating is a tenacious organic coating comprising a polymer chemical composition and a coupling agent;

the lubricous coating has a mass loss of less than about 5% of its mass when heated from a temperature of 150 °C to 350 °C at a ramp rate of about 10 °C/minute; and

the coefficient of friction is a maximum coefficient of friction measured relative to a second glass container in a vial-on-vial testing jig under a normal load of 30 N, the second glass container having a body formed from the aluminosilicate glass composition and comprising the lubricous coating on an at least a portion of the outer surface of a body of the second glass container and subjected to the same environmental conditions prior to measurement.

2. The glass container of claim 1, wherein the glass container is ion-exchange strengthened.

3. A glass container comprising:

a body formed from an aluminosilicate glass composition, the body having a hydrolytic resistance of HGB2 or better according to ISO 719 and an inner surface, an outer surface and a wall thickness extending between the outer surface and the inner surface, wherein the body is ion-exchange strengthened such that the body comprises a

compressively stressed layer extending into the wall thickness from at least one of the outer surface and the inner surface; and

a lubricous coating positioned on at least a portion of the outer surface of the body, wherein the portion of the outer surface of the body with the lubricous coating has a coefficient of friction less than or equal to 0.7, wherein:

the lubricious coating comprises a polymer chemical composition and a coupling agent;

the lubricous coating is a tenacious organic coating that is thermally stable at a temperature of at least about 260°C for 30 minutes; and

the coefficient of friction is a maximum coefficient of friction measured relative to a second glass container in a vial-on-vial testing jig under a normal load of 30 N, the second glass container having a body formed from the aluminosilicate glass composition and comprising the lubricous coating on an at least a portion of the outer surface of a body of the second glass container and subjected to the same environmental conditions prior to measurement.

4. The glass container of claim 1 or claim 3, wherein the tenacious organic coating is thermally stable at a temperature of at least about 300°C for 30 minutes.

5. The glass container of claim 1 or claim 3, wherein the compressively stressed layer has a surface compressive stress greater than or equal to 300 MPa.

6. The glass container of claim 1 or claim 3, wherein the compressively stressed layer has a depth of layer greater than or equal to 25 μm.

7. The glass container of claim 1 or claim 3, wherein a light transmission through the portion of the body with the lubricous coating is greater than or equal to about 55% of a light transmission through an uncoated glass article for wavelengths from about 400 nm to about 700 nm.

8. The glass container of claim 1 or claim 3, wherein the lubricous coating comprises:

a coupling agent layer positioned on the outer surface of the body, the coupling agent layer comprising the coupling agent; and

a polymer layer positioned over the coupling agent layer, the polymer layer comprising the polymer chemical composition.

9. The glass container of claim 8, wherein the coupling agent comprises at least one of:

a first silane chemical composition, a hydrolysate thereof, or an oligomer thereof; and

a chemical composition formed from the oligomerization of at least the first silane chemical composition and a second silane chemical composition, wherein the first silane chemical composition and the second silane chemical composition are different chemical compositions.