[0005] The amount of g-force that can be generated by a centrifuge depends at least in part on the physical properties of the rotor. Minor imperfections such as uneven distributions in mass or minor structural defects that would not be an issue in conventional centrifuges can cause vibrations or failures at the rotational speeds desired to efficiently separate exosomes.

[0006] Thus, there is a need for improved rotors that can be used in ultracentrifugation applications for separating exosomes and other materials having similar physical properties.

SUMMARY

[0007] Embodiments of the present invention overcome the foregoing and other shortcomings and drawbacks of centrifuge rotors heretofore known for use in ultra-high-speed centrifugation. While aspects the present invention will be discussed in connection with certain embodiments, it will be understood that the aspects of the present invention are not limited to the specific embodiments described herein.

[0008] According to an aspect of the present invention, a rotor for use in a centrifuge is provided. The rotor includes a rotor body having an axis of rotation, an upper surface, a lower surface opposite the upper surface, and an elongated bore extending along the axis of rotation between the upper surface and the lower surface. The upper surface of the rotor body includes a plurality cavities extending from the upper surface and into the rotor body, each of the plurality of cavities being configured to receive a sample container. The lower surface of the rotor body includes a lower bore opening in communication with the elongated bore and having a first cross-sectional shape transverse to the axis of rotation. The rotor further includes a drive hub mounted within the elongated bore and having a drive portion with a second cross-sectional shape transverse to the axis of rotation that is complementary to the first cross-sectional shape such that the drive portion of the drive hub applies torque to the rotor body via engagement of the drive portion with the lower bore opening of the rotor body. The drive hub further includes a lid,

wherein, the drive hub includes a cylindrical shaft that projects upwardly through the elongated bore from the drive portion of the drive hub, wherein an upper portion of the cylindrical shaft includes a threaded outer surface having threads with a major diameter and a minor diameter, further including a lid screw including a lower bore having a threaded inner surface, and a lid screw flange that extends radially outward from a lower end of the lid screw, wherein the threaded outer surface of the drive hub is configured to threadedly engage the threaded inner surface of the lower bore of the lid screw, and the lid screw flange has a lower surface configured to urge the lid into contact with the rotor body in response to threaded engagement of the lid screw and the drive hub.

[0009] In an embodiment of the present invention, each of the first cross-sectional shape and the second cross-sectional shape may be rectangular.

[0010] In another embodiment of the present invention, the rotor body may include an upper bore opening in communication with the elongated bore, and the

elongated bore may be cylindrical in cross-section transverse to the axis of rotation between the lower bore opening and the upper bore opening.

[0011]

[0012] In another embodiment of the present invention, the conical wall portion of the lid may be configured to engage each sample container placed into a respective cavity when the lid is operatively coupled to the rotor.

[0013] In another embodiment of the present invention, the upper surface of the rotor body may define an upper recess, and the central and conical wall portions of the lid may be received in the upper recess.

[0014]

[0015]

[0016]

[0017]

[0018]

[0019]

[0020]

[0021] In another embodiment of the present invention, the lower surface of the lid screw flange may include an annular groove, and the rotor may further include an elastic member positioned within the annular groove that is compressed against an upper surface of the central wall portion of the lid in response to threaded engagement of the lid screw with the drive hub.

[0022] In another embodiment of the present invention, the lower bore opening may include one or more sidewalls, the drive portion of the drive hub may have one or more faces each engaging a respective sidewall of the lower bore opening, and the application of torque to the rotor body may be by the one or more faces engaging the respective sidewalls.

[0023] Disclosed herein is a rotor for use in a centrifuge. The rotor includes a rotor body having an axis of rotation and an upper surface with a first annular groove, and a balance ring positioned in the first annular groove. The balance ring includes an upper surface and a plurality of apertures formed in the upper surface. Each aperture in the upper surface of the balance ring is configured to selectively receive a weight.

[0024] In the above disclosure, the rotor body may include a lower surface opposite its upper surface and an elongated bore extending along the axis of rotation between the upper and lower surfaces of the rotor body, and the rotor may further include a drive hub mounted within the elongated bore and having a cylindrical shaft that projects upwardly through the elongated bore. The cylindrical shaft may include an upper portion having a threaded outer surface. The rotor may further include a lid screw having a lower bore with a threaded inner surface configured to threadedly engage the threaded outer surface of the drive hub and a lid screw flange that extends radially outward from a lower end of the lid screw, a lid including a wall portion extending radially outward and including a lower surface having a second annular groove, and an elastic member positioned within the second annular groove that is compressed against the upper surface of the balance ring in response to threaded engagement of the lid screw with the drive hub.

[0025] In the above disclosure, the threaded outer surface may include threads having a major diameter and a minor diameter, and the cylindrical shaft may include

CLAIMS

1. A rotor for use in a centrifuge, comprising:

a rotor body including an axis of rotation, an upper surface, a lower surface opposite the upper surface, and an elongated bore extending along the axis of rotation between the upper surface and the lower surface, the upper surface of the rotor body including a plurality cavities extending from the upper surface and into the rotor body, each of the plurality of cavities being configured to receive a sample container, and the lower surface of the rotor body including a lower bore opening in communication with the elongated bore and having a first cross-sectional shape transverse to the axis of rotation; and

a drive hub mounted within the elongated bore and including a drive portion having a second cross-sectional shape transverse to the axis of rotation that is complementary to the first cross-sectional shape such that the drive portion of the drive hub applies torque to the rotor body via engagement of the drive portion with the lower bore opening of the rotor body, further comprising:

a lid, wherein,

the drive hub includes a cylindrical shaft that projects upwardly through the elongated bore from the drive portion of the drive hub,

wherein an upper portion of the cylindrical shaft includes a threaded outer surface having threads with a major diameter and a minor diameter, further comprising:

a lid screw including a lower bore having a threaded inner surface, and a lid screw flange that extends radially outward from a lower end of the lid screw, wherein the threaded outer surface of the drive hub is configured to threadedly engage the threaded inner surface of the lower bore of the lid screw, and the lid screw flange has a lower surface configured to urge the lid into contact with the rotor body in response to threaded engagement of the lid screw and the drive hub.

2. The rotor of claim 1, wherein

the lid includes a central wall portion, a conical wall portion extending upwardly and outwardly from the central wall portion, and an annular wall portion

extending radially outward from the conical wall portion remote from the central wall portion such that the annular wall portion is radially and axially offset from the central wall portion, and

wherein the lid includes a lid-lifting handle that projects axially upward form the central wall portion of the lid, and

wherein the lid-lifting handle includes a cylindrical wall having a handle flange projecting radially outward from a free end of the cylindrical wall remote from the central wall portion of the lid.

3. The rotor of claim 1 or claim 2, wherein the first cross-sectional shape and the second cross-sectional shape are each rectangular.

4. The rotor of claim 1, 2 or 3, wherein:

the rotor body includes an upper bore opening in communication with the elongated bore, and the elongated bore is cylindrical in cross-section transverse to the axis of rotation between the lower bore opening and the upper bore opening.

5. The rotor of claim 1 or 2, wherein the conical wall portion of the lid is configured to engage each sample container placed into a respective cavity when the lid is operatively coupled to the rotor.

6. The rotor of claim 1, 2 or 5, wherein the upper surface of the rotor body defines an upper recess, and the central wall portion and the conical wall portion of the lid are received in the upper recess.

7. The rotor of claim 1, wherein the cylindrical shaft includes a protruding end having the minor diameter and that extends a distance beyond the threads of the threaded outer surface.

8. The rotor of claim 2, wherein the cylindrical wall of the lid-lifting handle is configured to receive the lid screw flange and position the lid screw concentrically with the lid-lifting handle.

9. The rotor of claim 2 or 8, wherein the lower surface of the lid screw flange includes an annular groove, and further comprising an elastic member positioned within the annular groove that is compressed against an upper surface of the central wall portion of the lid in response to threaded engagement of the lid screw with the drive hub.

10. The rotor of any of claims 1 to 9, wherein the lower bore opening includes one or more sidewalls, the drive portion of the drive hub has one or more faces each engaging a respective sidewall of the lower bore opening, and the application of torque to the rotor body is by the one or more faces engaging the respective sidewalls.