We claim:

1. A method of quantifying the impact of shear stress on cells, wherein the method comprises the steps of

(a) exposing suspension cells to forces that cause shear stress; and

(b) immobilizing the suspension cells fom stap (a) using a cell and tissue adhesive;

(c) nanoindenting the immobilized cells from step (b); and

(d) determining mechanical properties of the immobilized cells at different stress levels, wherein the mechanical properties of the immobilized cells comprise cell stiffness.

2. The method according to claim 1, wherein the cells are mammalian cells.

3. The method according to claim 2, wherein the mammalian cells are Chinese Hamster Ovary (CHO) cells, Baby hamster kidney (BHK) cells, Human embryonic kidney 293 (HEK293) cells, HeLa cells, per.c6 cells, nonsecreting murine myeloma (NSo) cells, and Sp2/0 murine myeloma cells.

4. The method according to claim 3, wherein the cells are CHO cells.

5. The method according to claim 1, wherein the forces that cause shear stress to cells are generated by bioreactor agitation.

6. The method according to claim 1, wherein nanoindenting the cells is performed by a nanoindenter.

7. The method according to claim 6, wherein the nanoindenter comprises an optical probe.

8. The method according to claim 7, wherein the optical probe comprises a cantilever.

9. The method according to claim 7, wherein the optical probe is mechanically lowered from a pre-calibrated distance toward the surface of the immobilized cells.

10. The method according to claim 9, wherein the optical probe is lowered for a period of two seconds.

11. The method according to claim 8, wherein upon contact with the cantilever, the cell exerts a force upon the cantilever causing the cantilever to bend.

12. The method according to claim 11, wherein the optical probe is mechanically raised for a period of two seconds.

13. The method according to claim 11, wherein the cantilever is in contact with the cell surface for at least one second.

14. The method according to claim 13, wherein the cantilever is in contact with the cell surface for five seconds.

15. The method according to claim 13, wherein upon contact with the cell, the cantilever generates multiple increasing oscillation frequencies of 1F Hz, 2F Hz, 4F Hz, and 10F Hz.

16. The method according to claim 15 wherein no oscillation frequency is generated for a period of two seconds between the generation of each increasing oscillation frequency.

17. The method according to claim 6, wherein the nanoindenter subjects the cells to six rounds of nanoindentation.

18. The method according to claim 17, wherein each subsequent nanoindentation is placed 2μm from the preceding nanoindentation.

19. The method according to claim 1, wherein cell stiffness is determined by calculating Young's modulus (YM) and Effective Young's modulus (EYM).

20. The method according to claim 19, wherein the YM and EYM of cells after 26 hours of shear stress is less than about 50X Pa.

21. The method according to claim 19, wherein the YM and EYM of cells after 72 hours of shear stress is greater than about 500X Pa.

22. The method according to claim 1, wherein cell stiffness is determined by calculating storage modulus (E' value) or a loss modulus (E'' value).

23. The method according to claim 22, wherein the E' value calculated at frequencies of 1F, 2F, and 10F Hz is higher than the E" value calculated at frequencies of 1F, 2F, and 10F Hz after at least two days of agitation, thereby indicating elasticity of the immobilized cells.

24. The method according to claim 22, wherein the E" value calculated at a frequency of 4F Hz is higher than the E' value at a frequency of 4F Hz after at least two days of agitation, thereby indicating viscosity of the immobilized cells.

25. A process of bioproduction optimization, the process comprising:
(a) inflicting shear stress on a suspension of cells;
(b) quantifying the impact of shear stress on the suspension of cells according to the method of claim 1; and
(c) using the data obtained from step (b) to adjust the levels of shear force applied during bioproduction.

26. The process of claim 25, wherein optimization results in an increase in product titer and yield.

27. The process of claim 25, wherein optimization results in an increase in cell viability.

28. The process of claim 25, wherein optimization results in an increase in product quality.

29. The process of claim 28, wherein product quality is determined by glycosylation efficiency.

30. A method of developing cell lines that are resistant to shear stress, the method comprising
(a) inflicting shear stress on a suspension of cells with increasing levels of shear force;
(b) quantifying the impact of shear stress on cells according to the method of claim 1; and
(c) selecting resistant cells from step (b) for further use in bioproduction.

31. A cell line resistant to shear stress selected by the method of claim 30, comprising Chinese Hamster Ovary (CHO) cells, Baby hamster kidney (BHK) cells, Human embryonic kidney 293 (HEK293) cells, HeLa cells, per.c6 cells, nonsecreting murine myeloma (NSo) cells, and Sp2/0 murine myeloma cells.

32. The cell line resistant to shear stress of claim 31 comprising CHO cells that express antibodies.