

What is claimed is:

1. A configurable handheld biological analyzer for identification of biological products based on Raman spectroscopy, the configurable handheld biological analyzer comprising:
 - a first housing adapted for handheld manipulation;
 - a first scanner carried by the first housing;
 - a first processor communicatively coupled to the first scanner; and
 - a first computer memory communicatively coupled to the first processor,wherein the first computer memory is configured to load a biological classification model configuration, the biological classification model configuration comprising a biological classification model, wherein the biological classification model is configured to execute on the first processor, the first processor configured to (1) receive a first Raman-based spectra dataset defining a first biological product sample as scanned by the first scanner, and (2) identify, with the biological classification model, a biological product type based on the first Raman-based spectra dataset,
 - wherein the biological classification model configuration further comprises a spectral preprocessing algorithm, the first processor configured to execute the spectral preprocessing algorithm to reduce a spectral variance of the first Raman-based spectra dataset when the first Raman-based spectra dataset is received by the first processor, and
 - wherein the biological classification model comprises a classification component selected to reduce at least one of (1) a Q-residual error of the biological classification model, or (2) a summary-of-fit value of the biological classification model, the biological classification model configured to identify the biological product type of the first biological product sample based on the classification component.
2. The configurable handheld biological analyzer of claim 1, wherein the biological classification model configuration is electronically transferrable to a second configurable handheld biological analyzer, the second configurable handheld biological analyzer comprising:
 - a second housing adapted for handheld manipulation;
 - a second scanner coupled to the second housing;
 - a second processor communicatively coupled to the second scanner; and
 - a second computer memory communicatively coupled to the second processor,wherein the second computer memory is configured to load the biological classification model configuration, the biological classification model configuration comprising the biological classification model, wherein the biological classification model is configured to execute on the second processor, the second processor configured to (1) receive a second Raman-based spectra dataset defining a second biological product sample as scanned by the second scanner, and (2) identify, with the biological classification model, the biological product type based on the second Raman-based spectra dataset,
 - wherein the second biological product sample is a new sample of the biological product type.
3. The configurable handheld biological analyzer of claim 1, wherein the spectral variance is an analyzer-to-analyzer spectral variance between the first Raman-based spectra dataset and one or more other Raman-based spectra datasets of one or more corresponding other handheld biological analyzers, each of the one or more other Raman-based spectra datasets representative of the biological product type, and
 - wherein the spectral preprocessing algorithm is configured to reduce the analyzer-to-analyzer spectral variance between the first Raman-based spectra dataset and the one or more other Raman-based spectra datasets.

4. The configurable handheld biological analyzer of claim 3, wherein the spectral preprocessing algorithm comprises:
 - applying a derivative transformation to the first Raman-based spectra dataset to generate a modified Raman-based spectra dataset,
 - aligning the modified Raman-based spectra dataset across a Raman shift axis, and
 - normalizing the modified Raman-based spectra dataset across a Raman intensity axis.
5. The configurable handheld biological analyzer of claim 4, wherein the derivative transformation includes determining Raman weighted averages of consecutive groups of 11 to 15 Raman shift values across the Raman shift axis, and determining corresponding derivatives of those Raman weighted averages across the Raman shift axis.
6. The configurable handheld biological analyzer of claim 1, wherein the classification component is selected to reduce both of (1) the Q-residual error of the biological classification model and (2) the summary-of-fit value of the biological classification model.
7. The configurable handheld biological analyzer of claim 1, wherein the biological classification model further comprises a second classification component, the biological classification model configured to identify the biological product type of the first biological product sample based on the classification component and the second classification component.
8. The configurable handheld biological analyzer of claim 1, wherein the biological classification model is implemented as a principal component analysis (PCA) model.
9. The configurable handheld biological analyzer of claim 8, wherein the classification component is a first principal component of the PCA model.
10. The configurable handheld biological analyzer of claim 1, wherein the computer memory is configured to load a new biological classification model, the new biological classification model comprising an updated classification component.
11. The configurable handheld biological analyzer of claim 1, wherein the biological classification model configuration is implemented in an extensible markup language (XML) format.
12. The configurable handheld biological analyzer of claim 1, wherein the biological product type is of a therapeutic product.
13. The configurable handheld biological analyzer of claim 1, wherein the biological product type is identified by the biological classification model during manufacture of a biological product having the biological product type.
14. The configurable handheld biological analyzer of claim 1, wherein biological classification model is configured to distinguish, based on the classification component, the first biological product sample having the biological product type from a different biological product sample having a different biological product type.

15. The configurable handheld biological analyzer of claim 14, wherein the biological product type and the different biological product type each have distinct localized features within a same or similar Raman spectra range.

16. The configurable handheld biological analyzer of claim 1, wherein the biological classification model is configured to identify the biological product type of the first biological product sample based on the classification component when the Q-residual error or the summary-of-fit value satisfies a threshold value.

17. The configurable handheld biological analyzer of claim 16, wherein the biological classification model outputs a pass-fail determination based on the threshold value.

18. The configurable handheld biological analyzer of claim 1, wherein the biological classification model is generated by a remote processor being remote to the configurable handheld biological analyzer.

19. A biological analytics method for identification of biological products based on Raman spectroscopy, the biological analytics method comprising:

loading, into a first computer memory of a first configurable handheld biological analyzer having a first processor and a first scanner, a biological classification model configuration, the biological classification model configuration comprising a biological classification model;

receiving, by the biological classification model, a first Raman-based spectra dataset defining a first biological product sample as scanned by the first scanner;

executing a spectral preprocessing algorithm of the biological classification model to reduce a spectral variance of the first Raman-based spectra dataset; and

identifying, with the biological classification model, a biological product type based on the first Raman-based spectra dataset,

wherein the biological classification model comprises a classification component selected to reduce at least one of (1) a Q-residual error of the biological classification model, or (2) a summary-of-fit value of the biological classification model, the biological classification model configured to identify the biological product type of the first biological product sample based on the classification component.

20. The biological analytics method of claim 19, wherein the biological classification model configuration is electronically transferrable to a second configurable handheld biological analyzer, the biological analytics method further comprising:

loading, into a second computer memory of a second configurable handheld biological analyzer having a second processor and a second scanner, the biological classification model configuration, the biological classification model configuration comprising the biological classification model;

receiving, by the biological classification model, a second Raman-based spectra dataset defining a second biological product sample as scanned by the second scanner;

executing the spectral preprocessing algorithm of the biological classification model to reduce a second spectral variance of the second Raman-based spectra dataset; and

identifying, with the biological classification model, the biological product type based on the second Raman-based spectra dataset,

wherein the second biological product sample is a new sample of the biological product type.

21. The biological analytics method of claim 19, wherein the spectral variance is an analyzer-to-analyzer spectral variance between the first Raman-based spectra dataset and one or more other Raman-based spectra datasets of one or more corresponding other handheld biological analyzers, each of the one or more other Raman-based spectra datasets representative of the biological product type, and

wherein the spectral preprocessing algorithm is configured to reduce the analyzer-to-analyzer spectral variance between the first Raman-based spectra dataset and the one or more other Raman-based spectra datasets.

22. The biological analytics method of claim 21, wherein the spectral preprocessing algorithm comprises:
applying a derivative transformation to the first Raman-based spectra dataset to generate a modified Raman-based spectra dataset,
aligning the modified Raman-based spectra dataset across a Raman shift axis, and
normalizing the modified Raman-based spectra dataset across a Raman intensity axis.

23. The biological analytics method of claim 22, wherein the derivative transformation includes determining Raman weighted averages of consecutive groups of 11 to 15 Raman shift values across the Raman shift axis, and determining corresponding derivatives of those Raman weighted averages across the Raman shift axis.

24. The biological analytics method of claim 19, wherein the classification component is selected to reduce both of (1) the Q-residual error of the biological classification model and (2) the summary-of-fit value of the biological classification model.

25. The biological analytics method of claim 19, wherein the biological classification model further comprises a second classification component, the biological classification model configured to identify the biological product type of the first biological product sample based on the classification component and the second classification component.

26. The biological analytics method of claim 19, wherein the biological classification model is implemented as a principal component analysis (PCA) model.

27. The biological analytics method of claim 26, wherein the classification component is a first principal component of the PCA model.

28. The biological analytics method of claim 19, wherein the first computer memory is configured to load a new biological classification model, the new biological classification model comprising an updated classification component.

29. The biological analytics method of claim 19, wherein the biological classification model configuration is implemented in an extensible markup language (XML) format.

30. The biological analytics method of claim 19, wherein the biological product type is of a therapeutic product.

31. The biological analytics method of claim 19, wherein the biological product type is identified by the biological classification model during manufacture of a biological product having the biological product type.

32. The biological analytics method of claim 19, wherein biological classification model is configured to distinguish, based on the classification component, the first biological product sample having the biological product type from a different biological product sample having a different biological product type.

33. The biological analytics method of claim 32, wherein the biological product type and the different biological product type each have a same or similar Raman spectra range.

34. The biological analytics method of claim 19, wherein the biological classification model is configured to identify the biological product type of the first biological product sample based on the classification component when the Q-residual error or the summary-of-fit value satisfies a threshold value.

35. The biological analytics method of claim 34, wherein the biological classification model outputs a pass-fail determination based on the threshold value.

36. The biological analytics method of claim 19, wherein the biological classification model is generated by a remote processor being remote to the configurable handheld biological analyzer.

37. A tangible, non-transitory computer-readable medium storing instructions for identification of biological products based on Raman spectroscopy, that when executed by one or more processors of a configurable handheld biological analyzer cause the one or more processors of the configurable handheld biological analyzer to:

load, into a computer memory of the configurable handheld biological analyzer having a scanner, a biological classification model configuration, the biological classification model configuration comprising a biological classification model; receive, by the biological classification model, a Raman-based spectra dataset defining a biological product sample as scanned by the scanner;

execute a spectral preprocessing algorithm of the biological classification model to reduce a spectral variance of the Raman-based spectra dataset; and

identify, with the biological classification model, a biological product type based on the Raman-based spectra dataset, wherein the biological classification model comprises a classification component selected to reduce at least one of (1) a Q-residual error of the biological classification model, or (2) a summary-of-fit value of the biological classification model, the biological classification model configured to identify the biological product type of the biological product sample based on the classification component.