Claims

1. A system for processing extrusion data during an extrusion process performed by an extruder under predefined extrusion parameters, the system comprising:

a set of pre-extrusion instruments disposed along the extruder and configured for measuring, during the extrusion process, pre-extrusion material properties of an extrudate within the extruder as the extrudate moves through the extruder;

a set of post-extrusion instruments disposed outside the extruder and configured for measuring, during the extrusion process, post-extrusion material properties of the extrudate after the extrudate has exited the extruder; and

a processor for collecting the extrusion data comprising the extrusion parameters and the measured pre-extrusion and post-extrusion material properties of the extrudate,

wherein the processor is configured for building a materials database using the extrusion data; and

wherein the pre-extrusion instruments and/or post-extrusion instruments comprise one or more spectrometers for measuring morphological and/or chemical composition properties of the extrudate.

2. The system according to claim 1, wherein the pre-extrusion instruments and/or post-extrusion instruments are configured for measuring rheological properties of the extrudate.

3. The system according to claim 2, wherein the pre-extrusion instruments comprise one or more of a temperature sensor, pressure sensor, volume sensor, and torque sensor.

4. The system according to any one of claims 1 to 3, wherein the spectrometers comprise one or more of a Raman spectrometer, Fourier transform infrared spectrometer, colour spectrometer, and ultraviolet spectrometer.

5. The system according to claim 4, wherein the post-extrusion instruments comprise an optical sensor for measuring die swell of the extrudate.

6. The system according to any one of claims 1 to 5, wherein the pre-extrusion instruments and/or post-extrusion instruments are configured for measuring mechanical performance properties of the extrudate.

7. The system according to claim 6, wherein the post-extrusion instruments comprise a melt tension instrument configured for measuring melt tension properties of the extrudate.

8. The system according to claim 7, wherein the post-extrusion instruments comprise a set of rollers configured for rolling the extrudate to facilitate measurement of the melt tension properties.

9. A method for processing extrusion data during an extrusion process, the method comprising:

performing the extrusion process using an extruder under predefined extrusion parameters;

measuring, during the extrusion process, and using a set of pre-extrusion instruments disposed along the extruder, pre-extrusion material properties of an extrudate within the extruder as the extrudate moves through the extruder;

measuring, during the extrusion process and using a set of post-extrusion instruments disposed outside the extruder, post-extrusion material properties of the extrudate after the extrudate has exited the extruder;

measuring, during the extrusion process and using one or more spectrometers of the pre-extrusion instruments and/or post-extrusion instruments, morphological and/or chemical composition properties of the extrudate;

collecting, using a processor, the extrusion data comprising the extrusion parameters and the measured pre-extrusion and post-extrusion material properties of the extrudate; and

building a materials database using the processor and the extrusion data.

10. The method according to claim 9, further comprising reducing dimensionality of the extrusion data.

11. The method according to claim 9 or 10, further comprising training a machine learning model using the materials database.

12. The method according to claim 11, further comprising adjusting the extrusion parameters based on feedback received from the machine learning model.

13. The method according to claim 11 or 12, further comprising training, using the processor, the machine learning model to determine a set of output data based on a set of input data, the input data comprising extrusion parameters for an extrusion process and the output data comprising material properties of an extrudate created by the extrusion process.

14. The method according to claim 11 or 12, further comprising training, using the processor, the machine learning model to determine a set of output data based on a set of input data, the input data comprising material properties of an extrudate and the output data comprising extrusion parameters for an extrusion process to create the extrudate.

15. The method according to any one of claims 11 to 14, wherein the machine learning model is trained using a Bayesian optimization algorithm, a reinforcement learning algorithm, or a regression algorithm.

16. The method according to any one of claims 9 to 15, further comprising searching, using the machine learning model, the materials database based on a set of extrusion parameters for an extrusion process to create an extrudate and a set of material properties of the extrudate.

17. The method according to claim 16, further comprising adding, to the materials database, a new extrudate if an existing extrudate corresponding to the set of extrusion parameters and the set of material properties cannot be found in the materials database.