of reduced light, and corresponding information, that passes through the slit. The tradeoff between resolution and throughput is very hard to overcome by a physical spectrometer design alone.

SUMMARY

[005] Embodiments of the present disclosure seek to mitigate the above-described tradeoff with physical design parameters associated with conventional spectrometers.

[006] Embodiments of the present disclosure seek to enable use of a low resolution spectrometer to collect spectral data and be able to resolve finer details within the spectral data or images without sacrificing throughput or spectral range.

[007] According to a first aspect of the present invention, there is provided an apparatus that includes memory circuitry that stores a data set indicative of a state of a semiconductor fabrication process or of semiconductor structure fabricated thereby. Features in the data set are discernable to an extent limited by a data resolution. The memory circuitry also stores a machine-learning model comprising parameters having respective values assigned thereto as constrained by a model training process. Processor circuitry is communicatively coupled to the memory circuitry and generates an output data set from the data set in accordance with the machine-learning model such that features in the output data set are discernable to an extent limited by an output data resolution that is finer than the data resolution of the data set.

[007a] According to a second aspect of the present invention, there is provided a system for processing material for semiconductor fabrication comprising: a chamber in which the materials are contained, the chamber including a port through which the semiconductor fabrication processing is monitored; an data acquisition instrument communicatively coupled to the port of the chamber and that generates a data set indicative of a state of the semiconductor fabrication process, features in the data set being discernable to an extent limited by a data resolution of the data acquisition instrument; and processor circuitry communicatively coupled to the data acquisition instrument and that generates an output data set from the data set in accordance with a machine-learning model such that features in the output data set are discernable to an extent limited by an output data resolution that is finer than the data resolution of the data set, the machine-learning model comprising parameters having respective values assigned thereto as constrained by a model training process.

BRIEF DESCRIPTION OF THE DRAWINGS

[008] FIG. 1 is a schematic block diagram of an example system in which the present inventive concept can be embodied.

[009] FIG. 2 is a schematic diagram of an artificial neural network (ANN) by which the present invention can be embodied.

[0010] FIG. 3 is a schematic diagram of an example spectrometer with which the present invention can be embodied.

[0011] FIG. 4 is a schematic diagram of a spectrometer entrance slit and an image 420 thereof for simulating data in embodiments of the present invention.

[0012] FIG. 5 is a graph of low resolution spectral data for underfill and overfill implementations of low resolution spectrometers used in embodiments of the present invention.

[0013] FIG. 6 is a graph of high resolution spectral data for underfill and overfill implementations of high resolution spectrometers used in embodiments of the present invention.