CLAIMS

1. A method of imaging a biological sample, comprising:

projecting an optical pattern onto a biological sample and capturing a first image of the optical pattern overlaid on the biological sample, the biological sample being contained in an asymmetrically patterned flowcell comprising a plurality of elongated nanowells, wherein each of the elongated nanowells is elliptically shaped or rectangularly shaped;

phase shifting the projected optical pattern relative to the biological sample and capturing at least a second image of the phase shifted optical pattern overlaid on the biological sample; and

reconstructing a high resolution image representative of the biological sample based upon the first captured image and the at least second captured image.

2. The method of claim 1, wherein each of the plurality of elongated nanowells are oriented such that along a first axis of the asymmetrically patterned flowcell, resolution is increased to resolve information representative of the biological sample.

3. The method of claim 2, wherein each of the plurality of elongated nanowells are oriented such that along a second axis of the asymmetrically patterned flowcell, resolution is not increased to resolve information representative of the biological sample.

4. The method of claim 1, wherein the capturing of the first and the at least second images comprises performing line scanning imaging.

5. The method of claim 4, further comprising: directing light through an optical diffraction grating in a first phase and angle orientation, wherein the optical pattern projected onto the biological sample is an optical diffraction grating pattern generated by the light being directed

through the optical diffraction grating, wherein phase shifting the projected optical pattern relative to the biological sample comprises phase shifting the optical diffraction grating.

6. The method of claim 5, wherein the phase shifting of the optical diffraction grating comprises phase shifting the optical diffraction grating along the first angle orientation.

7. The method of claim 6, wherein the phase shifting of the optical diffraction grating occurs perpendicularly to a direction of the line scanning imaging.

8. The method of claim 1, further comprising:

directing light through an optical diffraction grating in a first phase and angle orientation, wherein the optical pattern projected onto the biological sample is an optical diffraction grating pattern generated by the light being directed through the optical diffraction grating, wherein phase shifting the projected optical pattern relative to the biological sample comprises phase shifting the optical diffraction grating; and

performing a third phase shift of the optical diffraction grating, projecting the optical diffraction grating pattern onto the biological sample and capturing at least a third image of the phase shifted optical diffraction grating pattern overlaid on the biological sample prior to reconstructing the high resolution image.

9. A method of imaging a biological sample, comprising:

directing light through an optical diffraction grating in a first phase and angle orientation;

projecting an optical diffraction grating pattern generated by the light being directed through the optical diffraction grating onto the biological sample and capturing a first image of the optical diffraction grating pattern overlaid on the biological sample, the biological sample

being contained in an asymmetrically patterned flowcell comprising a plurality of elongated nanowells, wherein each of the elongated nanowells is elliptically shaped or rectangularly shaped;

phase shifting the optical diffraction grating, projecting the optical diffraction grating pattern onto the biological sample and capturing at least a second image of the phase shifted optical diffraction grating pattern overlaid on the biological sample;

reorienting the optical diffraction grating to a second angle orientation, projecting the optical diffraction grating pattern onto the biological sample, and capturing a third image of the optical diffraction grating pattern overlaid on the biological sample;

phase shifting the optical diffraction grating, projecting the optical diffraction grating pattern onto the biological sample and capturing at least a fourth image of the phase shifted optical diffraction grating pattern overlaid on the biological sample; and

reconstructing a high resolution image representative of the biological sample based upon the first, the at least second, the third, and the at least fourth captured images.

10. A system, comprising:

a laser source emitting a light beam;

an optical diffraction grating adapted to generate an optical diffraction grating pattern upon passage of the emitted light beam through the optical diffraction grating;

a camera assembly adapted to capture a plurality of images of optical diffraction grating pattern overlaid on a biological sample, the plurality of images reflecting three phases of the optical diffraction grating relative to the biological sample, wherein the biological sample is located in a flowcell comprising a plurality of nanowells that are oriented in an asymmetrical

array and wherein each of the plurality of nanowells are elliptically shaped or rectangularly shaped; and

a processor adapted to reconstruct a high resolution image representative of the biological sample based on a combination of the plurality of images.

11. The system of claim 10, wherein each of the plurality of nanowells are oriented such that along a first axis of the flowcell, resolution is increased to resolve information representative of the biological sample.

12. The system of claim 11, wherein each of the plurality of nanowells are oriented such that along a second axis of the flowcell, resolution is not increased to resolve information representative of the biological sample.

13. A system, comprising:

a laser source emitting a light beam;

an optical diffraction grating adapted to generate an optical diffraction grating pattern upon passage of the emitted light beam through the optical diffraction grating;

a camera assembly adapted to capture a plurality of images of optical diffraction grating pattern overlaid on a biological sample, the plurality of images reflecting three phases of the optical diffraction grating relative to the biological sample, wherein the camera assembly comprises a time delay integration line scanning camera assembly; and

a processor adapted to reconstruct a high resolution image representative of the biological sample based on a combination of the plurality of images.

14. The system of claim 13, wherein the biological sample is contained in a flowcell, different portions of which are overlaid with representations of the three phases of the optical diffraction grating simultaneously.

15. The system of claim 13, wherein the optical diffraction grating comprises three phase stepped elements, wherein each of the three phase stepped elements is adapted to generate an optical diffraction grating pattern upon passage of the emitted light beam through the phase stepped element, wherein the camera assembly is adapted to capture an image of an optical diffraction grating pattern generated by each of the three phase stepped elements overlaid on the biological sample.

16. The system of claim 15, wherein the camera assembly comprises three image sensors, each of the three image sensors adapted to capture the image of the optical diffraction grating pattern generated by a respective one of the phase stepped elements.

17. A system, comprising:

a laser source emitting a light beam;

an optical diffraction grating adapted to generate an optical diffraction grating pattern upon passage of the emitted light beam through the optical diffraction grating;

a camera assembly adapted to capture a plurality of images of optical diffraction grating pattern overlaid on a biological sample, the plurality of images reflecting three phases of the optical diffraction grating relative to the biological sample and two angular orientations of the optical diffraction grating relative to the biological sample, wherein the biological sample is located in a flowcell comprising a plurality of nanowells that are oriented in an asymmetrical

array and wherein each of the plurality of nanowells are elliptically shaped or rectangularly shaped; and

a processor adapted to reconstruct a high resolution image representative of the biological sample based on a combination of the plurality of images.

18. The system of claim 17, wherein each of the plurality of nanowells are oriented such that resolution is increased to resolve information representative of the biological sample along first and second axes of the flowcell.