CLAIMS

What is claimed is:

1. An apparatus, comprising:

a collimator at an input end positioned to receive an input beam from a fiber beam source and to produce a substantially collimated beam;

a beam shaping group comprising one or more optical elements and positioned to receive the substantially collimated beam from the collimator and format the substantially collimated beam into a shaped propagation beam having a substantially rectangular cross-section in a far field; and

a focusing objective stage including an objective pupil for receiving the shaped propagation beam and positioned to transform the shaped propagation beam into a substantially rectangular cross-section sampling beam at or near a focal plane of the focusing objective stage for optically probing a sample.

2. The apparatus of claim 1, further comprising:

an optical relay stage positioned between the beam shaping group and the focusing objective stage for imaging the shaped propagation beam from the beam shaping group onto or near the objective pupil of the focusing objective stage.

3. The apparatus of claim 2, wherein the optical relay stage comprises an input lens stage positioned to receive the shaped propagation beam from the beam shaping group and an output lens stage positioned to produce the shaped propagation beam to the objective pupil of the focusing objective stage.

4. The apparatus of claim 3, wherein the input lens stage and the output lens stage form a focusing element pair defining an intermediate image plane within the optical relay stage.

5. The apparatus of claim 4, the optical relay stage having a beam affecting element at the intermediate image plane.

6. The apparatus of claim 5, wherein the beam affecting element is an optical mask or a despeckling element.

7. The apparatus of claim 3, wherein a position of at least one of the input lens stage and the output lens stage is adjustable.

8. The apparatus of claim 2, further comprising a Powell lens or a Lineman lens positioned before to the optical relay stage.

9. The apparatus of claim 2, wherein the optical relay stage is one or more of afocal, a fixed magnification relay, or a variable magnification relay.

10. The apparatus of claim 1, further comprising the fiber beam source.

11. The apparatus of claim 10, wherein the fiber beam source is a two-input beam source to generate the input beam having a first beam over a first wavelength range and having a second beam over a second wavelength range, different than the first wavelength range.

12. The apparatus of claim 11, wherein the fiber beam source comprises two dedicated input fibers each corresponding to one of the first beam and the second beam.

13. The apparatus of claim 12, wherein output ends of the two dedicated input fibers are presented to the collimator with fixed spacing and with rotation about fiber cores and a collimator axis.

14. The apparatus of claim 10, 11, or 12, wherein each input fiber has a substantially rectangular cross-section at an exit face.

15. The apparatus of claim 10, wherein the fiber beam source is a light pipe.

16. A method, comprising:

receiving, at a collimator, an input beam from a fiber beam source;

producing, by the collimator, a substantially collimated beam from the input beam;

receiving the substantially collimated beam from the collimator at a beam shaping group comprising one or more optical elements;

formatting, by the beam shaping group, the substantially collimated beam into a shaped propagation beam having a substantially rectangular cross-section in a far field;

receiving the shaped propagation beam at a focusing objective stage including an objective pupil;

transforming the shaped propagation beam into a substantially rectangular cross-section sampling beam at or near a focal plane of the focusing objective stage; and

optically probing a sample using the focusing objective stage.

17. The method of claim 16, further comprising generating the input beam having a first beam over a first wavelength range and having a second beam over a second wavelength range, different than the first wavelength range.

18. The method of any one of claims 16 – 17, further comprising generating the input beam using a two-input beam source.

19. The method of claim 18, wherein the fiber beam source comprises two dedicated input fibers each corresponding to one of the first beam and the second beam.

20. The method of claim 19, wherein output ends of the two dedicated input fibers are presented to the collimator with fixed spacing and with rotation about fiber cores and a collimator axis.

21. The method of claim 16, wherein affecting optical compensation of the optical relay stage comprises adjusting a position or an optical property of an affecting element within the optical relay stage.

22. The method of claim 16, wherein the beam shaping group comprises two arrays of microlenses.

23. The method of claim 16, wherein the beam shaping group comprises a diffractive optical element.

24. The method of claim 16, wherein the beam shaping group comprises a refractive optical element, a combination of a refractive optical element and a diffractive optical element, or a refractive optical element with integral diffractive features.

25. The method of claim 16, wherein the beam shaping group transforms the collimated beam into the shaped propagation beam having a uniform illumination in the far field over a rectangle having a ratio of at least one of 8 to 1, 10 to 1, 24 to 1, between about 10 to 1 and about 20 to 1, or approximately 1.