CLAIMS

1. A method of forming sub-resolution features, the method comprising:

exposing a photoresist layer formed over a substrate to a first ultraviolet light (UV) radiation having a first wavelength of 365 nm or longer through a mask configured to form features at a first critical dimension, the photoresist layer comprising first portions exposed to the first UV radiation and second portions unexposed to the first UV radiation after exposing with the first UV radiation;

exposing the first portions and the second portions to a second UV radiation;

developing the photoresist layer after exposing the photoresist layer to the second UV radiation to form the sub-resolution features having a second critical dimension less than the first critical dimension;

depositing a layer of a spacer material over the sub-resolution features;

performing a spacer etch back to remove a lateral portion of the spacer material;

performing a pull etch to remove the sub-resolution features and form a spacer pattern; and

performing a pattern transfer etch using the spacer pattern as an etch mask.

2. The method of claim 1, further comprising, before developing, performing a post-exposure bake by thermally treating the substrate.

3. The method of claim 1, further comprising selecting conditions for exposing the first portions and the second portions to the second UV radiation to form the sub-resolution features having a height less than a first height of the features.

4. The method of claim 1, further comprising selecting conditions for exposing the first portions and the second portions to the second UV radiation to form the sub-resolution features having a width between 200 nm and 360 nm, a height between 20 nm and 900 nm, or a ratio of height to width between 3 and 100.

5. The method of claim 1, wherein exposing the first portions and the second portions to the second UV radiation is performed using a pixel-based projection system having an array of independently addressable projection points.

6. The method of claim 1, wherein the first wavelength is 365 nm and the second wavelength is 266 nm.

7. A method of forming sub-resolution features, the method comprising:

exposing a photoresist layer formed over a substrate to a first ultraviolet light (UV) radiation having a first wavelength of 365 nm or longer through a first mask configured to form features at a first critical dimension, the photoresist layer comprising first portions exposed to the first UV radiation and second portions unexposed to the first UV radiation after exposing with the first UV radiation;

developing the photoresist layer after exposing the photoresist layer to the first UV radiation to remove the first portions;

depositing a resin over the photoresist layer; and

exposing the second portions to a second UV radiation having a second wavelength;

developing the photoresist layer after exposing the photoresist layer to the second UV radiation to form the sub-resolution features having a second critical dimension less than the first critical dimension, the sub-resolution features comprising a trench between the photoresist layer and the resin.

8. The method of claim 7, wherein depositing the resin before exposing the second portions to the second UV radiation, the second UV radiation inducing a photochemical reaction generating an acid within the second portions, the acid laterally diffusing into the resin to form acid-reacted layers on side walls of the resin.

9. The method of claim 8, wherein developing the photoresist layer after exposing the photoresist layer to the second UV radiation removes the acid-reacted layers, and wherein widths of the acid-reacted layers determine the second critical dimension.

10. The method of claim 8, further comprising, before exposing the second portions to the second UV radiation, inserting a second mask into an optical path of the second UV radiation.

11. The method of claim 7, wherein the resin is deposited over the photoresist layer after exposing the second portions to the second UV radiation, wherein exposing the second portions comprises forming third portions exposed to the second UV radiation by converting a portion of the second portions, the remaining second portions forming fourth portions not being exposed to the second UV radiation.

12. The method of claim 11, wherein the third portions cover sidewalls of the fourth portions.

13. The method of claim 11, wherein developing the photoresist layer comprises removing top portions of the resin to expose the third portions, and removing the third portions.

14. The method of claim 7, further comprising performing a pattern transfer etch using the sub-resolution features as an anti-spacer.

15. A lithography tool comprising:

a chamber sized and configured to receive a wafer for processing;

a wafer holder to hold a 200 mm wafer;

a first ultraviolet light (UV) radiation source configured to emit a first UV radiation having a first wavelength of 365 nm, the first UV radiation source configured to form first features having a first critical dimension larger than a first optical resolution limit based on the first UV radiation;

a second UV radiation source configured to emit a second UV radiation having a second wavelength, the second UV radiation source configured to form second features having a second critical dimension larger than a second optical resolution limit based on the

second UV radiation;

wherein the lithography tool comprises instructions to

expose a photoresist layer formed over the wafer with the first UV radiation through a first mask configured to form the first features at the first critical dimension, the photoresist layer comprising first portions exposed to the first UV radiation and second portions unexposed to the first UV radiation;

develop the photoresist layer after exposing the photoresist layer to the first UV radiation to remove the first portions;

deposit a resin over the photoresist layer;

exposing the second portions to the second UV radiation; and

develop the photoresist layer after exposing the second portions to the second UV radiation to define sub-resolution features having a critical dimension less than the first optical resolution limit.

16. The lithography tool of claim 15, further comprising an image projection system configured to expose the second portions to the second UV radiation.

17. The lithography tool of claim 16, wherein the image projection system comprises a digital light processing (DLP) device or grating light valve (GLV) device.

18. The lithography tool of claim 16, wherein the image projection system is configured to spatially control the second UV radiation by varying light intensity or light frequency of the second UV radiation.

19. The lithography tool of claim 15, wherein the critical dimension of the sub-resolution features is less than the second optical resolution limit.

20. The lithography tool of claim 15, further comprising an instruction to insert a second mask before exposing the second portions to the second UV radiation.