CLAIMS

1. A method of monitoring the operation of a radiation source fuel droplet stream generator comprising a fuel-containing capillary and a piezo-electric actuator attached to said capillary, the method comprising analysing the resonance frequency spectrum of a system comprising the fuel-containing capillary and the piezo-electric actuator.

2. The method of monitoring the operation of a radiation source fuel droplet stream generator as claimed in claim 1, further comprising detecting changes in the resonance frequency spectrum.

3. The method of monitoring the operation of a radiation source fuel droplet stream emitter as claimed in claim 2, further comprising analysing the resonance frequency spectrum to detect changes in said spectrum resulting from vibrations of said generator.

4. The method of monitoring the operation of a radiation source fuel droplet stream emitter as claimed in claim 2, further comprising analysing the resonance frequency spectrum to detect changes in said spectrum resulting from at least partial blockage of an outlet nozzle of said capillary.

5. The method of monitoring the operation of a radiation source fuel droplet stream emitter as claimed in claim 2, further comprising analysing the resonance frequency spectrum to detect changes in said spectrum resulting from damage to said capillary.

6. The method of monitoring the operation of a radiation source fuel droplet stream emitter as claimed in claim 2, further comprising analysing the resonance frequency spectrum to detect changes in said spectrum resulting from a change in the strength of the attachment of the piezo-electric actuator to said capillary.

7. The method of monitoring the operation of a radiation source fuel droplet stream generator as claimed in any preceding claim, further comprising sampling a signal in a drive circuit of said piezo-electric actuator.

8. The method of monitoring the operation of a radiation source fuel droplet stream generator as claimed in claim 7, wherein said signal is sampled in the drive side of said circuit.

9. The method of monitoring the operation of a radiation source fuel droplet stream generator as claimed in claim 7, wherein said signal is sampled in the common side of said circuit.

10. The method of monitoring the operation of a radiation source fuel droplet stream generator of claim 2, wherein the resonance frequency spectrum is analysed intermittently.

11. The method of monitoring the operation of a radiation source fuel droplet stream generator as claimed in any preceding claim, wherein the resonance frequency spectrum is analysed continuously.

12. A radiation source fuel droplet stream generator, comprising: a capillary configured to contain fuel, a piezo-electric actuator secured to said capillary, a circuit configured to drive said actuator, and an analyser configured to analyse the resonance frequency spectrum of a system comprising the fuel-containing capillary and the piezo-electric actuator.

13. The radiation source fuel droplet stream generator of claim 12, wherein said analyser comprises a sampler configured to sample the signal in said drive circuit.

14. The radiation source fuel droplet stream generator of claim 13, wherein said sampler comprises a frequency response analyser.

15. The radiation source fuel droplet stream generator of claim 13 or 14, wherein said sampler is located in a drive side of said drive circuit.

16. The radiation source fuel droplet stream generator as claimed in claim 13 or 14, wherein said sampler is located in a common side of said drive circuit.

17. A lithographic projection apparatus, comprising:

a radiation source fuel droplet stream generator as claimed in any of claims 12 to 16,

a radiation generator configured to generate radiation from a fuel droplet stream,

an illumination system configured to condition a radiation beam;

a support constructed to support a patterning device, the patterning device being capable of imparting the radiation beam with a pattern in its cross-section to form a patterned radiation beam;

a substrate table constructed to hold a substrate; and

a projection system configured to project the patterned radiation beam onto a target portion of the substrate.

18. A device manufacturing method, comprising:

generating a stream of fuel droplets using a fuel droplet generator having a capillary configured to contain fuel, a piezo-electric actuator attached to said capillary, a circuit configured to drive said actuator, and an analyser configured to analyse the resonance frequency spectrum of a system comprising the fuel-containing capillary and the piezo-electric actuator,

generating radiation from said fuel droplet stream; and

projecting a patterned beam of radiation through an opening in a projection system onto a substrate.

CLAIMS

1. A method of monitoring the operation of a radiation source fuel droplet stream generator (200) comprising a fuel-containing capillary (304) and a piezo-electric actuator (306) attached to said capillary (304), the method comprising analysing the resonance frequency spectrum of a system comprising the fuel-containing capillary (304) and the piezo-electric actuator (306).

2. The method of monitoring the operation of a radiation source fuel droplet stream generator as claimed in claim **1**, further comprising detecting changes in the resonance frequency spectrum.

3. The method of monitoring the operation of a radiation source fuel droplet stream generator as claimed in claim **2**, further comprising analysing the resonance frequency spectrum to detect changes in said spectrum resulting from vibrations of said generator.

4. The method of monitoring the operation of a radiation source fuel droplet stream generator as claimed in claim **2**, further comprising analysing the resonance frequency spectrum to detect changes in said spectrum resulting from at least partial blockage of an outlet nozzle (308) of said capillary (304).

5. The method of monitoring the operation of a radiation source fuel droplet stream generator as claimed in claim **2**, further comprising analysing the resonance frequency spectrum to detect changes in said spectrum resulting from damage to said capillary (304).

6. The method of monitoring the operation of a radiation source fuel droplet stream generator as claimed in claim **2**, further comprising analysing the resonance frequency spectrum to detect changes in said spectrum resulting from a change in the strength of the attachment of the piezo-electric actuator (306) to said capillary (304).

7. The method of monitoring the operation of a radiation source fuel droplet stream generator as claimed in any preceding claim, further comprising sampling a signal in a drive circuit of said piezo-electric actuator (306).

8. The method of monitoring the operation of a radiation source fuel droplet stream generator as claimed in claim **7**, wherein said signal is sampled in the drive side of said circuit.

9. The method of monitoring the operation of a radiation source fuel droplet stream generator as claimed in claim **7**, wherein said signal is sampled in the common side of said circuit.

10. The method of monitoring the operation of a radiation source fuel droplet stream generator of claim **2**, wherein the resonance frequency spectrum is analysed intermittently.

11. The method of monitoring the operation of a radiation source fuel droplet stream generator as claimed in any preceding claim, wherein the resonance frequency spectrum is analysed continuously.

12. A radiation source fuel droplet stream generator, comprising: a capillary (304) configured to contain fuel, a piezo-electric actuator (306) secured to said capillary (304), a circuit configured to drive said actuator (306), and **characterized in that** said generator comprises an analyser (504) configured to analyse the resonance frequency spectrum of a system comprising the fuel-containing capillary (304) and the piezo-electric actuator (306).

13. The radiation source fuel droplet stream generator of claim **12**, wherein said analyser (504) comprises a sampler configured to sample the signal in said drive circuit.

14. The radiation source fuel droplet stream generator of claim **13**, wherein said sampler comprises a frequency response analyser (504).

15. The radiation source fuel droplet stream generator of claim **13** or **14**, wherein said sampler is located in a drive side of said drive circuit.

16. The radiation source fuel droplet stream generator as claimed in claim **13** or **14**, wherein said sampler is located in a common side of said drive circuit.

17. A lithographic projection apparatus (100), comprising:

a radiation source fuel droplet stream generator (200) as claimed in any of claims **12** to **16**,

a radiation generator configured to generate radiation from a fuel droplet stream,

an illumination system (IL) configured to condition a radiation beam (B);

a support (MT) constructed to support a patterning device (MA), the patterning device (MA) being capable of imparting the radiation beam (B) with a pattern in its cross-section to form a patterned radiation beam;

a substrate table (WT) constructed to hold a substrate (W); and

a projection system (PS) configured to project the patterned radiation beam onto a target portion of the substrate (W).

18. A device manufacturing method, comprising:

generating a stream of fuel droplets using a fuel droplet generator (200) having a capillary (304) configured to contain fuel, a piezo-electric actuator (306) attached to said capillary (304), a circuit configured to drive said actuator (306), and an analyser (504) configured to analyse the resonance frequency spectrum of a system comprising the fuel-containing capillary (304) and the piezo-electric actuator (306),

generating radiation from said fuel droplet stream; and

projecting a patterned beam of radiation through an opening in a projection system (PS) onto a substrate (W).