CLAIMS

What is claimed is:

1. A laser stimulated lock-in thermography (LLT) crack detection system comprising:

a spatial light modulator for reflecting a laser beam to focus the laser beam onto a sample for detection of a crack, hole or scratch; and

a controller coupled to the spatial light modulator for controlling operation of the spatial light modulator to switch focus of the laser beam onto the sample between a plurality of LLT focus configurations for detection of the crack, hole or scratch on the sample.

2. The system in accordance with Claim 1 wherein the spatial light modulator comprises an electrically tuned diffractive optical element to control divergence angle and spot size or line width for focus of the laser beam onto the sample between the plurality of LLT focus configurations.

3. The system in accordance with either Claim 1 or Claim 2 wherein the plurality of LLT focus configurations comprise one or more spot LLT focus configurations.

4. The system in accordance with Claim 3 wherein the plurality of LLT focus configurations comprise at least a single-spot LLT focus configuration and a multi-spot LLT focus configuration.

5. The system in accordance with any preceding claim wherein the plurality of LLT focus configurations comprise one or more line LLT focus configurations.

6. The system in accordance with Claim 5 wherein the plurality of LLT focus configurations comprise at least a single-line LLT focus configuration and a multi-line LLT focus configuration.

7. The system in accordance with any preceding claims further comprising an infrared camera for recording an incidence of the laser beam on the sample to identify the crack, hole or scratch on the sample.

8. The system in accordance with Claim 7 further comprising a chopper in the path of the laser beam wherein the infrared camera and the chopper are coupled to the controller for synchronizing chopping of the laser beam with recording of the laser beam incidence on the sample.

9. The system in accordance with any preceding claim wherein the sample comprises a metal sample or a composite material sample.

10. The system in accordance with any preceding claim wherein the controller is configured to further switch focus of the laser beam onto the sample between the plurality of LLT focus configurations for determination of one or more parameters of the crack, hole or scratch on the sample.

11. The system in accordance with Claim 10 wherein the one or more parameters of the crack, hole or scratch on the sample comprise one or more of dimensions or properties of the crack, hole or scratch on the sample.

12. The system in accordance with Claim 11 wherein one or more of dimensions of the crack, hole or scratch on the sample comprise the length, width, or depth of the crack, hole or scratch with arbitrary orientation on the sample.

13. A method for laser stimulated lock-in thermography (LLT) crack detection in a system capable of switching between a plurality of LLT configurations on a sample, the method comprising:

using a first one of the plurality of LLT configurations for coarse scanning of the sample to detect a crack, hole or scratch on the sample; and

when a crack, hole or scratch is detected on the sample, switching to a second one of the plurality of LLT configurations for fine scanning of the crack, hole or scratch on the sample to determine one or more parameters of the crack, hole or scratch on the sample.

14. The method in accordance with Claim 13 wherein the one or more parameters of the crack, hole or scratch on the sample comprise one or more of dimensions or properties of the crack, hole or scratch on the sample.

15. The method in accordance with Claim 14 wherein the one or more of dimensions of the crack, hole or scratch on the sample comprise the length, width, or depth of the crack, hole or scratch on the sample.

16. The method in accordance with any of Claims 13 to 15 wherein the first one of the plurality of LLT configurations comprise at least one of a multi-spot LLT focus configuration or a multi-line LLT focus configuration.

17. The method in accordance with any of Claims 13 to 16 wherein the second one of the plurality of LLT configurations comprise at least a single-spot LLT focus configuration.

18. The method in accordance with any of Claims 13 to 17 further comprising before the coarse scanning step:

using the second one of the plurality of LLT configurations; and

deducing one or more properties of the sample.

19. The method in accordance with Claim 18 wherein the one or more properties comprise optical properties of the sample or thermal properties of the sample.

20. The method in accordance with either Claim 18 or Claim 19 further comprising after the step of deducing one or more properties of the sample and before the coarse scanning step switching to use a single-spot LLT configuration or a single-line LLT configuration to determine a suitable spot and/or line size and a LLT divergence angle for the sample.