Claims

[Claim 1] A method for adaptively splitting a partially coherent primary light beam by means of a Spatial Light Modulator (SLM), comprising

providing the partially coherent primary light beam by means of a collimated laser beam from one of the list comprising a nanosecond laser, a picosecond laser, a femtosecond laser,

producing a desired far-field distribution, which is not dependent on the profile of the partially coherent primary light beam, by phase modulating the partially coherent primary light beam with the spatial light modulator, the partially coherent primary light beam being directed to reflect on a display element of the spatial light modulator, thereby avoiding any moving element to shape the primary coherent light beam,

extracting from the partially coherent primary light beam, after the partially coherent primary light beam has passed the spatial light modulator, a monitoring beam and a main beam,

directing the desired far-field distribution produced by the spatial light modulator in the monitoring beam onto a sensor surface of a camera and measuring the monitoring beam with the camera,

whereby in a first option, the method comprises

guiding the partially coherent primary light beam through a first focusing element (L1) that is configured to

generate the desired far-field distribution in the main beam onto a focusing plane of the first focusing element as a real output distribution, as well as

projecting the desired far-field distribution in the monitoring beam onto the sensor surface by means of the first focusing element (L1),

and in a second option, the method comprises

guiding the monitoring beam through a second focusing element (L2) that is configured to project the desired far-field distribution only onto the sensor surface,

and for either the first or the second option
match a dynamic range of the camera by using a variable intensity regulator to control the intensity of the incoming monitoring beam as a function of the desired far-field distribution, independent of the average power of the main beam,
configuring a closed loop to enable a phase calculation for the display element of the spatial light modulator, whereby an output signal from the camera is input into the closed loop for a plurality of iterations of a phase-calculation algorithm performed by a controller,
wherein
in the first option, the first focusing element is used, excluding the second focusing element, and
in the second option, the second focusing element is used, excluding the first focusing element.

[Claim 2] The method of claim 1, further comprising
structuring a solid surface with the main beam, and
controlling the structuring by setting the spatial light modulator to obtain a determined profile for the partially coherent primary light beam.

[Claim 3] The method of claim 2, using the first option, further comprising
adjusting the focusing plane of the first focusing element for the step of structuring the solid surface, such that the focusing plane corresponds to the solid surface.

[Claim 4] The method of claim 2, using the first option, further comprising
adjusting the focusing plane of the first focusing element to an intermediate plane, and imaging the intermediate plane by means of a projecting optical set-up in a reduced scale onto the solid surface.

[Claim 5] The method of claim 2, using the second option, wherein
the step of structuring involves applying the desired far-field distribution, for obtaining the structures on the solid surface, by

projecting the desired far-field distribution by means of a focusing optical set-up onto the solid surface.

[Claim 6] The method according to any one of claims 1 to 5, wherein the step of extracting involves a beam-splitting element, the method further comprising
integrating the beam-splitting element, the first and the second focusing elements, the spatial light modulator, the variable intensity regulator, and the camera into a single compact enclosure, whereby the single compact enclosure is configured to be an exclusive component to be placed in the partially coherent primary light beam,
switching between the first option and the second option by means of a controller device, and
adjusting the variable intensity regulator by means of the controller device.

[Claim 7] The method according to any one of claims 1 to 2, using the second option, further comprising
splitting the partially coherent primary light beam into a plurality of partial main beams by means of the spatial light modulator,
individually adjusting a number of the plurality of partial main beams, angles of separation between each of the plurality of partial main beams after the plurality of partial main beams leaves the display element of the spatial light modulator, and intensities of each of the plurality of partial main beams among each other by phase control, wherein the intensities of the plurality of partial main beams among each other is controlled by the controller that is further configured to control an individual generation for each of the plurality of partial main beams, the spatial light modulator and the partially coherent primary light beam, and
structuring the solid surface with the plurality of partial main beams.

[Claim 8] The method according to any one of claims 2 to 5, wherein the solid surface comprises any one of the list comprising metal, diamond, sapphire, glass, plastic, composite materials, leather.

[Claim 9] The method according to any one of claims 2 to 5, and 8, wherein the solid surface is a part of a working tool.

[Claim 10] The method according to claim 9, wherein the working tool is any one of the list comprising an embossing roller, a stamping device, a metal tool, a wristwatch component, a jewelry part, a packaging component.

[Claim 11] A device configured for an adaptive splitting of a partially coherent primary light beam by means of a Spatial Light Modulator (SLM), whereby the partially coherent primary light beam is from a collimated laser beam from one of the list comprising a nanosecond laser, a picosecond laser, a femtosecond laser, the device comprising

the spatial light modulator configured to produce a desired far-field distribution, which is not dependent on the profile of the partially coherent primary light beam, by phase modulation of the partially coherent primary light beam, whereby the spatial light modulator is further configured to obtain the partially coherent primary light beam from a display element of the spatial light modulator, thereby avoiding any moving element to shape the partially coherent primary light beam;

a beam splitting element positioned in the partially coherent primary light beam after the partially coherent primary light beam has passed the spatial light modulator, and configured to extract from the partially coherent primary light beam, an intended monitoring beam and an intended main beam;

a camera positioned in the intended monitoring beam and further comprising a sensor surface configured to measure the desired far-field distribution produced by the spatial light modulator in the monitoring beam,

whereby in a first configuration option, the device comprises

a first focusing element (L1) configured to

project the desired far-field distribution produced by the spatial light modulator in the monitoring beam onto the sensor surface, and further configured to

guide the partially coherent primary light beam and generate the desired far-field distribution in the main beam onto a focusing plane of the first focusing element as a real output distribution;

and in a second configuration option, the device comprises

a second focusing element (L2) positioned in the intended monitoring beam and configured to project the desired far-field distribution produced by the spatial light modulator only onto the sensor surface,

and for either the first or the second configuration option, the device further comprises

a variable intensity regulator positioned in the intended monitoring beam in front of the camera, and configured to match a dynamic range of the camera by control of the intensity of the incoming intended monitoring beam as a function of the desired far-field distribution, independent of the average power of the main beam;

a closed-loop set-up configured to enable a phase calculation for the display element of the spatial light modulator, comprising a controller connected to the camera to receive an output signal, and configured to use the output signal for a plurality of iterations of a phase-calculation algorithm performed in the controller,

the device further comprising switching means configured to switch between the first configuration option and the second configuration option, wherein

in the first configuration option, the first focusing element is used, excluding the second focusing element, and

in the second configuration option, the second focusing element is used, excluding the first focusing element.

[Claim 12] A machining device configured for a machining of an intended solid surface, comprising the device according to claim 11, the machining

device configured for the machining of the intended solid surface further configured to position the intended solid surface in the main beam, whereby the machining of the intended solid surface results from at least a setting of the spatial light modulator to the effect of producing a determined profile for the partially coherent primary light beam.

[Claim 13] The machining device of claim 12, wherein the device according to claim 11 is configured in the first configuration option, and further wherein the focusing plane of the first focusing element (L1) is configured to correspond to the intended solid surface.

[Claim 14] The machining device of claim 12, wherein the device according to claim 11 is configured in the first configuration option, further comprising a imaging optical set-up, the first focusing element being positioned such that its focusing plane corresponds to an intermediate plane, and the imaging optical set-up being configured such that the imaging optical set-up images the intermediate plane in a reduced scale onto the solid surface.

[Claim 15] The machining device of claim 12, wherein the device according to claim 11 is configured in the second configuration option, further comprising a focusing optical set-up, and the focusing optical set-up being configured such that the focusing optical set-up projects the desired far-field distribution of the main beam onto the solid surface for the machining.

[Claim 16] The device of claim 11, further comprising a single compact enclosure configured to integrate the beam-splitting element, the first and second focusing elements, the spatial light modulator, the variable intensity regulator, and the camera, whereby the single compact enclosure is configured to be an exclusive component to be placed into the partially coherent primary light beam;
further wherein the controller is configured to control the switching means to switch between the first configuration option and the second configuration

option, and to adjust the variable intensity regulator.

[Claim 17] The machining device according to claim 12, wherein
the spatial light modulator is enabled to split the partially coherent primary light beam into a plurality of partial main beams, and to individually adjust a number of the plurality of partial main beams, angles of separation between each of the plurality of partial main beams after the plurality of partial main beams leaves the display element of the spatial light modulator, and intensities of the plurality of partial main beams among each other by phase control,
wherein the controller is further configured to control the intensities of each of the plurality of partial main beams among each other, by control of spatial physical properties for each of the plurality of partial main beams, whereby the spatial physical properties are at least one of phase and amplitude, the spatial light modulator and the partially coherent primary light beam,
the device being further configured to position the intended solid surface in the plurality of main beams.

[Claim 18] The machining device according to any one of claims 12 to 15 and 17, wherein the intended solid surface is a surface of an intended embossing roller and the controller is further configured to position the surface of the intended embossing roller in the main beam.

[Claim 19] The machining device of any one of claim 12 to 15, wherein the intended solid surface comprises any one of the list comprising metal, diamond, sapphire, glass, plastic, composite material, leather.

[Claim 20] The machining device according to any one of claims 12 to 15, and 19, wherein the intended solid surface is a part of an intended working tool.

[Claim 21] The machining device according to claim 20, wherein the intended working tool is any one of the list comprising an embossing roller, a

stamping device, a metal tool, a wristwatch component, a jewelry part, a packaging component.