CLAIMS

What is claimed is:

1. An inner nozzle portion for a powder feeding nozzle capable of being coaxially arranged within an outer nozzle portion of the powder feeding nozzle, the inner nozzle portion comprising:

an upper section having a plurality of defined shapes on a surface thereof configured to manipulate a stream of powder flowing across said surface of the upper section; and

a lower section having a substantially flat conical surface for forming a channel between said substantially flat conical surface and an inner surface of the outer nozzle portion when the inner nozzle portion is coupled to the outer nozzle portion, the inner nozzle portion being in communication with a powder inlet for receiving the stream of powder to flow across the surface of the upper section through the channel and towards a powder discharge outlet of the channel, wherein

the upper section comprises a recessed portion, and the plurality of defined shapes is arranged on the recessed portion, and

the recessed portion has a generally concave profile and extends circumferentially around the upper section.

2. The inner nozzle portion according to claim 1, wherein the plurality of defined shapes comprises a plurality of protrusions.

3. The inner nozzle portion according to claim 1, wherein the plurality of defined shapes comprises a plurality of holes, each hole configured for supporting a protrusion such that the protrusion protrudes from the surface of the upper section.

~~4 The inner nozzle portion according to claim 1, wherein the upper section comprises a recessed portion, and the plurality of defined shapes is arranged on the recessed portion.~~

~~5. The inner nozzle portion according to claim 4, wherein the recessed portion has a generally concave profile and extends circumferentially around the upper section.~~

~~6~~4. The inner nozzle portion according to any one of claims 1 to 3, wherein the lower portion has a generally conical profile having a narrower tip portion at the powder discharge outlet.

~~7~~5. The inner nozzle portion according to claim ~~6~~4, wherein the inner nozzle portion comprises an opening extending along its longitudinal axis in communication with a laser outlet at the narrower tip portion, the opening forming a passage for a laser beam.

~~8~~6. The inner nozzle portion according to claim ~~7~~5, wherein the channel is configured to discharge the stream of powder from the powder discharge outlet with a powder focus intersecting the laser beam at a predetermined distance from the narrower tip portion.

~~9~~7. The inner nozzle portion according to any one of claims 1 to 6, where the plurality of defined shapes is arranged in staggered rows on the surface of the upper section for promoting uniform mixing of the powder.

~~10~~8. The inner nozzle portion according to claim 2, wherein the plurality of protrusions is formed integrally with the upper section.

~~11~~9. The inner nozzle portion according to claim 2 or 3, wherein the plurality of protrusions is releasably coupled to the surface of the upper section.

~~12~~10. The inner nozzle portion according to claim 2 or 3, wherein the plurality of protrusions is generally hemispherical in shape.

~~13~~11. A powder feeding nozzle, comprising:

an inner nozzle portion according to any one of claims 1 to ~~12~~10; and

an outer nozzle portion, wherein the inner nozzle portion is coaxially arranged within the outer nozzle portion for defining said channel therebetween in communication with the powder discharge outlet.

~~14~~12. The powder feeding nozzle according to claim 13, wherein the outer nozzle portion comprises the powder inlet arranged to supply powder directly to the surface of the upper section of the inner nozzle portion.

~~15~~13. The powder feeding nozzle according to claim ~~13~~11 or 12, wherein a gap of the channel at the powder discharge outlet ~~is arranged~~ is in the range of about 0.1 mm to 1 mm.

~~16~~14. An assembly for laser aided additive manufacturing, the assembly comprises:

a body configured to be coupled to a controller and for receiving a laser beam;

a powder feeding nozzle including the inner nozzle portion according to any one of claims 1 to ~~12~~10 and an outer nozzle portion, wherein the inner nozzle portion is coaxially arranged within the outer nozzle portion for defining said channel therebetween in communication with the powder discharge outlet, and the powder feeding nozzle is coupled to an end of the body, and

adjustment mechanisms on the body for aligning the powder feeding nozzle with respect to the laser beam.

~~17~~15. A method for laser aided additive manufacturing, the method comprises:

arranging a powder feeding nozzle for receiving a laser beam, the powder feeding nozzle including the inner nozzle portion according to any one of claims 1 to ~~12~~10 and an outer nozzle portion, wherein the inner nozzle portion is coaxially arranged within the outer nozzle portion for defining said channel therebetween in communication with the powder discharge outlet;

directing the laser beam output from the powder feeding nozzle towards a substrate for generating a melt pool on the substrate; and

feeding powder through the powder discharge outlet of the powder feeding nozzle to the melt pool for forming a desired clad on the substrate.