



## COAXIAL POWDER NOZZLES FOR HIGHER LASER OUTPUT POWERS

### Task

One key objective of laser material deposition is to increase the deposition rate. Laser output powers in the multi-kW region are used to this end. These high laser output powers call for the development of new robust powder feed nozzles. Existing coaxial powder nozzles (angular gap nozzles) at Fraunhofer ILT with high powder efficiency (> 90 percent) were designed for a laser output power of up to 2.5 kW. A coaxial powder nozzle is being developed for laser material deposition that is designed for laser output powers of up to 5 kW, can handle higher powder mass streams > 1.5 kg/h and achieves powder efficiency of > 90 percent.

### Method

As part of developing powder nozzles for laser material deposition, the distance between the powder nozzle and workpiece surface (stand-off) has been increased from 8 to 13 mm in order to reduce heating caused by reflected laser radiation. The nozzle cooling has also been improved by means of design measures.

### Result

Tests have been conducted over 8 hours at 5 kW laser output power and 2.8 kg/h powder mass stream. The newly developed powder nozzle is being used successfully for cladding large hydraulic cylinders. Cladding speeds of 6 - 8 m/min have been achieved as part of these tests. Processing rates per unit area are 132 cm<sup>2</sup>/min at a feed rate of 6 m/min and a beam diameter of 2.2 mm; deposition rates at 50 percent overlap are therefore around 2 cm<sup>3</sup>/min with an achieved powder efficiency of > 90 percent and a layer thickness of 0.3 mm.

### Applications

Potential applications include material deposition for large components that require a combination of robust equipment and high powder efficiency. Examples include material deposition of wear and anti-corrosion layers on cylindrical components such as hydraulic and oilfield components requiring cladding times of several hours.

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1 Coaxial powder nozzle for higher laser output powers.