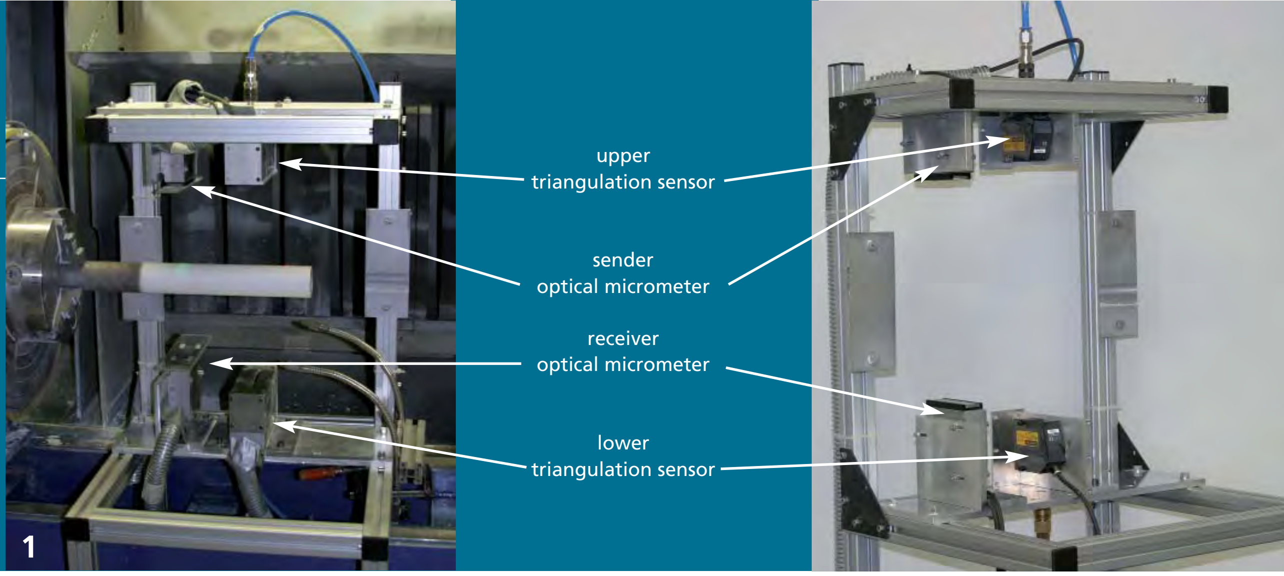


POSSIBILITIES FOR ONLINE COATING THICKNESS MEASUREMENT DURING THERMAL SPRAYING

THE TASK

There are several important economic factors related to thermal spraying, including the selection of the right spraying material and the desired coating thickness. For the latter it is critical to actually achieve targeted thickness as precisely as possible. Putting down too much material and exceeding the specified thickness can substantially increase costs.

Typical methods to determine the coating thickness rely on offline measurements, which either involve the interruption of the coating process, or the utilization of test samples that run in parallel to the actual part coating. Some of these methods only work for particular substrate and coating materials. Therefore concepts to measure the coating thickness during the process without the need for physical contact are of critical importance to the cost effectiveness of thermal spraying solutions.

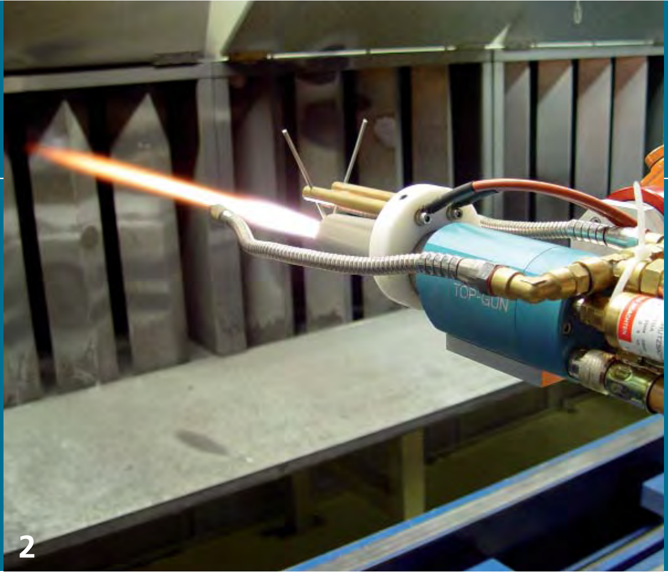
Fraunhofer IWS engineers evaluated the technical possibilities for simple contactless optoelectronic measurement techniques to determine the coating thickness online during the thermal spray process such as atmospheric plasma spraying (APS) and high velocity oxygen fuel spraying (HVOF). The most important task was to determine the reliability of the various methods including the data spread and possible disturbances.

OUR SOLUTION

Two different optical methods were tested for online monitoring. An optical micrometer determines geometric changes of the measured object. A laser triangulation sensor on the other hand, determines the coating thickness via the change of a defined distance between measurement object and sensor. By integrating the measurement systems into the spraying system the data can be collected during the spraying process.

A solid steel roll was used for the evaluation of the measurement techniques. The thermal spray process used about 30 passes of the spray gun to deposit an aluminum oxide coating of 450 µm. The online systems collected data after each pass. After every 10 passes the thickness was measured offline using caliper and magnetic inductive thickness measurements. Afterward the data sets were compared.

The influence of additional factors was investigated that may disturb the online measurements. Examples are the thermal expansion of the workpieces, the surface roughness of the coating, the radiation of flame or plasmas and mechanical influence form the spraying machine such as vibrations of the rotational axis.



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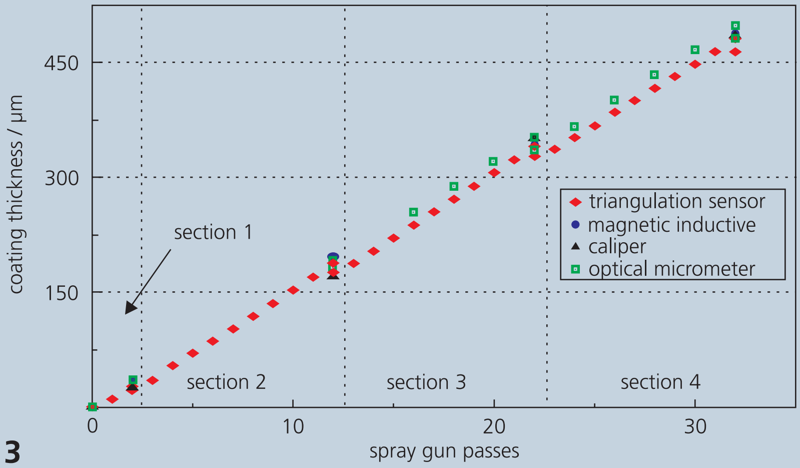
RESULTS

The optical micrometer as well as the triangulation sensor proved suitable for online thickness measurements during thermal spray processes. Both datasets clearly show the stepwise increase in coating thickness, which corresponds to a measurement after each pass. The deviations in comparison to the offline data are minor.

Increasing coating thickness during the APS experiment with four coating sections and comparison of online measurement systems with offline measurement methods



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A direct comparison reveals that the optical micrometer provides higher accuracy and stability (Fig. 3). However, the triangulation sensor is more flexible in terms of part geometry.

The roll's thermal expansion substantially contributed to distorting the online measured coating thickness values. Thus it will be required to correct this influence by simultaneously measuring the temperature of the part and correcting for the expansion in the software system. The accuracy of the data points with compensation was ± 5 to ± 10 µm for the optical micrometer and ± 10 to ± 20 µm for the triangulation sensor.

1 Measurement setup

2 HVOF gun during operation

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