

Optical Characterization of the Composition of Paint Droplets in Flight

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The quality of coatings in spray painting depends largely on the composition of the paint particles that are produced during the atomization process. These so-called dynamic paint droplets decisively determine the homogeneity, color tone and surface structure of the end product. Despite the high degree of automation of modern painting processes, there is still no suitable method for monitoring the composition of individual paint particles in flight to the substrate. The present work describes a novel optical method and an associated device ParticleTensorAI® with which the composition of dynamic paint droplets is characterized by their temporally resolved light scattering signals.

The method is based on the analysis of the temporal sequence of light scattering intensities that occur when a paint particle passes through a shaped light beam. Time-dependent light scattering is detected by two or more detectors. From the order and structure of the light scattering signals, it can be determined whether the paint particle is to be classified as semi-transparent or non-transparent. By statistically evaluating many such events, the relative number of semi-transparent particles can be determined, which allows conclusions to be obtained about the composition of the paint particles N_{rel} .

Experimental validation was carried out by analyzing paint droplets in a spray made from materials with different weight ratios between basecoat and paint concentrate $C_m = \{3\%, 5\%, 11\%, 13\%, 17\%, 23\%\}$. The droplets were classified and counted according to their degree of transparency. The resulting frequencies were calculated and compared with the respective mixing ratio. The results show a clear correlation between C_m and N_{rel} (see Fig. 1). As the proportion of the paint concentrate increases, the proportion of semi-transparent paint particles decreases. This behavior confirms the suitability of the presented method for quantitative characterization of the composition of dynamic paint particles in the coating process.

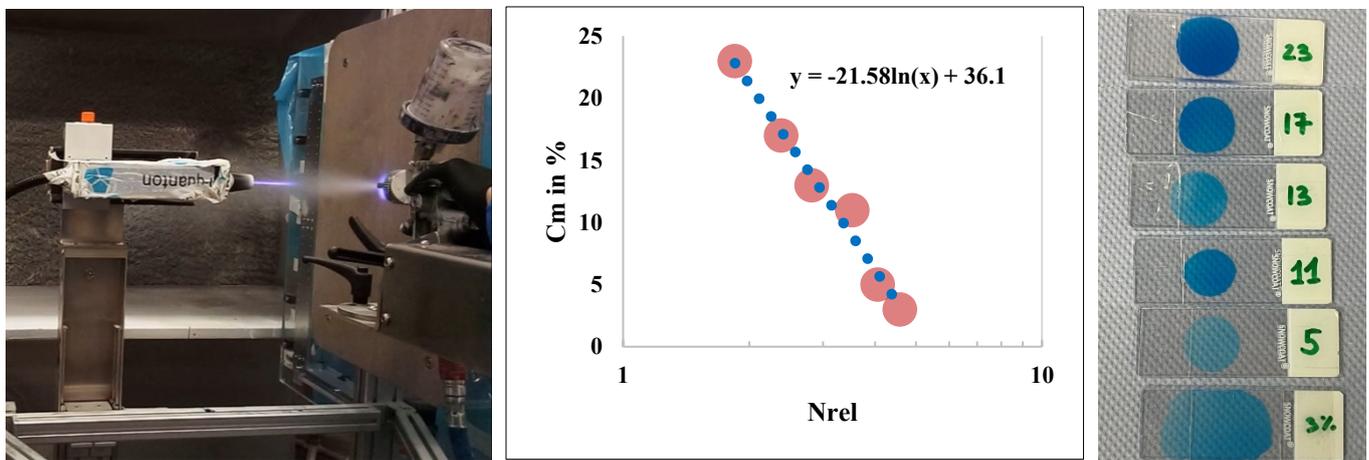


Figure 1: (left) Experimental setup with the measuring probe and a pneumatic atomizer. (middle) Correlation between the weight mixing ratio C_m and the relative number N_{rel} of semi-transparent paint droplets. As the proportion of the paint concentrate decreases, the number of semi-transparent paint particles increases. (right) Paint samples of the materials examined. The unexpected visual differences in transparency result from slight variations in the distance between the slides.

References

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