

Dissertation title:

Formation of Paint Film Structure in Spray Painting

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In addition to color and gloss, the surface structure is an important quality feature for the characterization of the optical quality of a paint film. In the past years a division into structure shares of five wavelength ranges W_a (0.1 to 0.3 mm), W_b (0.3 to 1 mm), W_c (1 to 3 mm), W_d (3 to 10 mm) and W_e (10 to 30 mm) has been established in the industrial environment for the description of the surface structure.

Because of a large number of influences on the generation of surface structure, such as atomization fineness, substrate structure or position of the substrate surface (horizontal/vertical), coatings often exhibit significantly different surface structures after drying and curing. Thus, the paint films can have differing optical appearances, so that the marketing ability of high quality products is not assured.

In costly optimization tests it is attempted to generate an acceptable surface structure by empirical adjustment of the process parameters. In many cases, the desired structures only can be achieved through cost intensive sanding and polishing processes, as well as by multiple coating.

With this work a self-contained 3D model is provided which includes the main mechanisms of surface structure formation of coating films in spray painting. By numerical investigations with a simulation program developed in the context of this work, a deeper understanding of the process of the formation of surface structures in spray painting could be provided in addition. The different influences of the various structure forming mechanisms on the wavelength ranges W_a to W_e are deduced. In this way measures can be derived for a targeted optimization of the process parameters. The 3D model and the results of the numerical investigations could be applied successfully to a real coating process. Through this work, it is now possible for the first time to realize targeted model-based optimizations of the spray painting process concerning the surface structure formation.