Use of Hyperspectral Imaging for the Quantification of Organic Contaminants on Copper Surfaces for Electronic Applications

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To correctly assess the cleanliness of technical surfaces in a production process, corresponding online monitoring systems must provide sufficient data. A promising method for fast, large-area, and non-contact monitoring is hyperspectral imaging (HSI), which was used in this paper for the detection and quantification of organic surface contaminations. Depending on the cleaning parameter constellation, different levels of organic residues remained on the surface. Afterwards, the cleanliness was determined by the carbon content in the atom percent on the sample surfaces, characterized by XPS and AES. The HSI data and the XPS measurements were correlated, using machine learning methods, to generate a predictive model for the carbon content of the surface. The regression algorithms elastic net, random forest regression, and support vector machine regression were used. Overall, the developed method was able to quantify organic contaminations on technical surfaces. The best regression model found was a random forest model, which achieved an R^2 of 0.7 and an RMSE of 7.65 At.-% C. Due to the easy-to-use measurement and the fast evaluation by machine learning, the method seems suitable for an online monitoring system. However, the results also show that further experiments are necessary to improve the quality of the prediction models.

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