Recyclable Food Packaging: Quality Control for Nanocoatings

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Across the EU, more than 300 billion items of packaging are not recycled every year because they consist of a mixture of different materials. Monomaterial packaging on the other hand is easy to recycle. However, it needs to be coated with ultra-thin barrier layers to protect delicate products just as well as compound materials do. The Fraunhofer team is developing an optical measurement system enabling the inline quality control of these barrier layers.

Nowadays, packaging for delicate everyday products generally consists of plastic compounds – a mixture of different polymers. This packaging protects products, such as food or pharmaceuticals, from environmental influences, like oxygen diffusion, all the way from production to consumption. While polymer compound materials perform these functions, they cannot be recycled economically. In light of the enormous amount of packaging, the German government and the EU have recently considerably tightened the rules for the recyclability of packaging. As part of the RE-USE research project, four Fraunhofer institutes are working on novel packaging approaches that do not rely on material compounds and can therefore be recycled to a much larger extent.

Monomaterials replacing compounds: Today, most packaging is incinerated as waste as it consists of compound materials. Fraunhofer researchers are developing barrier layers that are only several nanometers thin to produce recyclable packaging consisting of monomaterials and increase the recycling rate. To this end, a team at Fraunhofer IPM is developing a process to check the quality of the layers during production.

Ultra-thin barrier layer on monomaterial packaging

In many cases, ultra-thin coatings, for example consisting of aluminum oxide or silicon

dioxide, can also perform the barrier function of polymers. The project partners are developing a process aimed at making it possible to apply coatings as thin as 10 nanometers that reliably act as a barrier. These layers are so thin – and the amount of secondary material applied to the actual packaging therefore so small – that the packaging can be easily recycled as a monomaterial.

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Infrared reflectometry provides information on layer thickness and composition

Such “super barriers” can only be produced at scale if reliable quality control mechanisms are in place. This is why one of the aims of the research project, which is scheduled to run for three years, is an inline-capable measurement system which regulates the coating process and thus ensures continuous quality control. Fraunhofer IPM will develop a solution which can thoroughly check (and also regulate) the thickness and composition of the barrier layer during the manufacturing process. This technology relies on the characteristic spectral properties of the different coatings in the infrared region. Infrared radiation from a quantum cascade laser hitting the barrier layer at a grazing angle is able to “see” the layer, i. e. the spectral signatures of both coating and substrate. These spectral characteristics can then be interpreted to give information about the thickness and chemical composition of the layer.

In another project funded by the Land of Baden-Württemberg, the research team is collaborating with PLASMA ELECTRONIC GmbH to apply the infrared-optical process in production using an array of extremely compact individual sensors as part of an industrial plasma coating process for cups. This enables 100 percent quality control.

Read the original article on Fraunhofer Institute for Electronic Nano Systems.