HEPTAMETHINES AND UV-RADICAL INITIATORS RESULT IN DRIED COLORLESS POLYMER NETWORKS COMBINING OF HIGH-POWER NIR AND UV-LEDS

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Requirements of economic and ecological aspects of the society have led to the development of new energy-efficient devices used for manufacturing; that is new high-power LEDs with emission in the NIR and the UV range. Combination of these devices with absorbers such as cyanines derived from heptamethines enables efficient overlap of the emission and absorption. Regarding the energy efficiency, this is a huge benefit compared to conventional oven systems and also conventional NIR-Radiators which emit in a broad wavelength region wasting lots of energy.

These cyanines convert the majority of the absorbed energy into heat by radiationless deactivation, which can be used to improve the physical drying of waterborne dispersions such as polyurethanes. High temperatures (up to 160 °C) can be obtained up NIR exposure (0.05 - 0.2 wt%; thickness: 80 µm-160 µm). In addition, the drying time of the coating, which is measured with ATR-FTIR, can significantly decreased. The best drying results regarding drying time and appearance can be obtained with a thickness of 80 µm and absorber conc. of 0.05 - 0.1 wt%. High concentration and high layer thickness result in excessive absorption leading to strong blistering, and color change. Decomposition products of the cyanines exhibiting brownish/yellowish color depict a major problem in this case.

Surprisingly, recent investigations using UV-VIS-NIR measurements showed that the combination of these cyanines with Type-I photoinitiators such as TPO-L results in complete bleaching of the absorbers, which is a possible pathway to obtain colorless coatings bringing huge progress in this field. DMA measurements also showed that it is possible to combine the waterborne polyurethane dispersion with different multifunctional acrylates such as UDMA, TMPTA, HDDA and TPGDA to form new colorless polymer network system after NIR drying and UV curing. TPO-L served as photoinitiator in these experiments.