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Spectroscopic Analysis of the Aging Behavior of Polymers for Solar Thermal Applications

Diploma Thesis

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Abstract

Due to the increasing prices of raw materials for solar thermal collectors, it is a major concern to identify alternative materials for solar thermal applications. Polymers offer a wide diversity of materials and properties. The adoption of polymers in solar thermal applications demands strong durability and weatherability.

The climatic impacts have been analyzed on two polymers (PPS and PPE-PS). Therefore, they have been exposed indoors and outdoors. The accelerated indoor aging tests were performed with systematic variation of UV irradiation, temperature and humidity. The outdoor aging tests were carried out in Freiburg, Germany and Gran Canary, Spain. Raman-Microscopy and IR-Spectroscopy has been used to investigate changes of these two polymers over the time. Based on these results, conclusions concerning durability and weatherability of the samples could be drawn.

It can be seen that UV irradiation has the strongest impact on both polymers by inducing photo-degradation reactions. PPE-PS is very sensitive to the operating temperatures of conventional solar thermal collectors, so that thermal degradation can be assumed. The aggressive variation of 85°C, 85% r.h. and UV irradiation effects strong degradation on the surface of PPS.

The results suggest the necessity of an adapted system concept, which protects the polymers conveniently. Furthermore, continuative analysis of the aging behavior of alternative polymers should be performed.