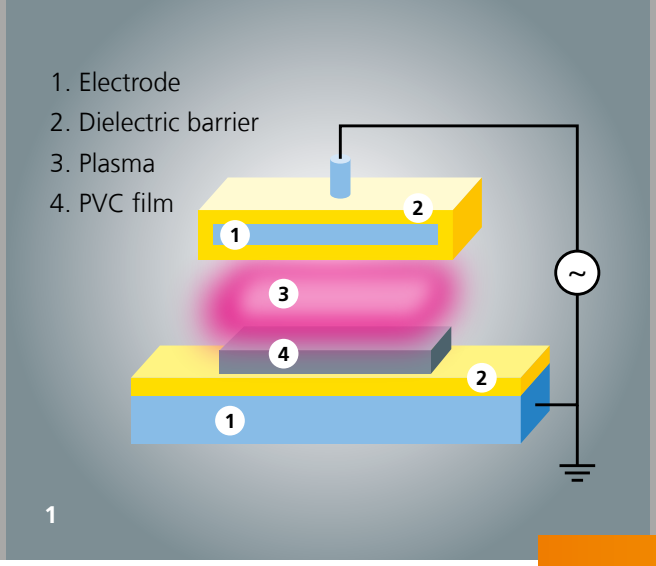

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Extract from the annual report 2016
To the website: www.ist.fraunhofer.de/en.html

REDUCING THE MIGRATION OF PVC PLASTICIZERS

Many medical products such as blood bags or flexible tubes are made of polyvinyl chloride (PVC). This material is inexpensive, transparent, weldable and has low-temperature flexibility. To obtain the flexibility up to 40 wt.% of plasticizer has to be added to the material. In most cases these plasticizers are not chemically bound to the polymer but can move freely within the polymer matrix and also in the surrounding medium. However, the plasticizers normally used, such as bis(2-ethylhexyl) phthalate (DEHP), are considered problematic for human health. For this reason, in current research at Fraunhofer IST processes are developed, which reduce or completely prevent the migration of plasticizers from the polymer, by coating or cross-linking the PVC.

The approach

Dielectric-barrier discharges (DBD) at atmospheric pressure are used at the Fraunhofer IST for treating or coating the PVC plastics in order to reduce plasticizer migration. Here the PVC substrates are positioned between high-voltage electrodes with dielectric barriers. In the gas space between the electrodes an AC voltage generates a dielectric-barrier discharge (see Figure 1). Different effects can be achieved by selecting appropriate process gases. For example, if the process gas contains a film-forming precursor such as hexamethyldisiloxane, plasma polymer layers can be deposited in the process. On the other hand, other process gases such as pure argon generate very short-wave UV radiation, which has sufficient energy to break chemical bonds and thus can lead to a cross-linking of the polymers.

Results

It was demonstrated at the Fraunhofer IST that the migration of plasticizers from plasticized PVC can be reduced by 95 percent by treatment in pure argon plasma (see Figure 2). Current knowledge attributes this effect to the plastic being cross-linked by the very short-wave UV radiation of the argon plasma. It was also demonstrated that the treatment is stable in the long term (see Figure 3) and depends on the purity of the process gas. In addition to the treatment of flat film material, processes have been developed which allow even the interior surfaces of tubes and blood bags to be successfully modified and coated.

Outlook

Dielectric-barrier discharges are regarded in industry as a cost-effective way of treating plastic film before printing, gluing or painting. For this reason, current research is being conducted into the modification of film webs and the associated effects of further processing steps for medical products such as welding or gluing. In addition, various combinations of different processes are being tested with a view to reducing migration further. Future research will also look at whether results can be transferred to other polymers and the migration of other ingredients.

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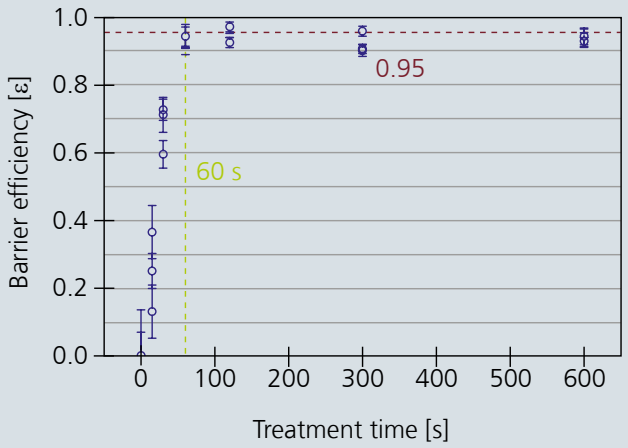
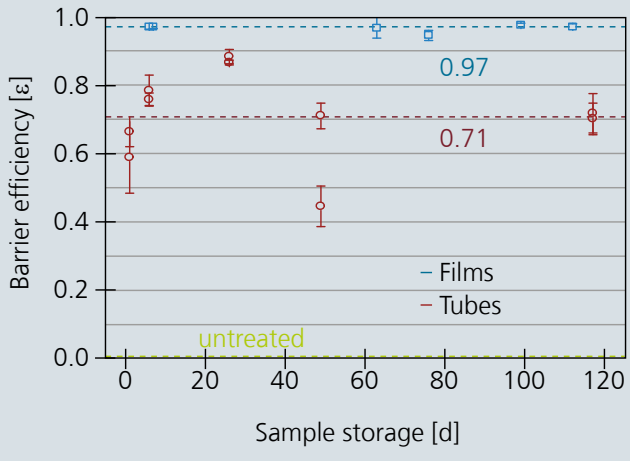
Barrier efficiency as a function of treatment time in argon plasma.



Long-term stability of barrier efficiency.



1 *Experimental set-up for the DBD treatment of PVC film.*

2 *Installation for treating film by dielectric barrier discharge.*

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