



P-5-1078

PHOTOCROSSLINKING OF HIGHLY SOFTEN TPUS WITH UV RADIATION AND COMPARISON OF THEIR MECHANICAL PROPERTIES WITH THE TPU AND UV CURABLE ACRYLATED PU WITH SIMILAR STRUCTURE

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In the present research, photocrosslinking of highly soft thermoplastic polyurethanes (TPUs) with ultraviolet (UV) radiation was studied. Polytetramethylene glycol (PTMG) with $M_n = 3000$ (gr/mol) was used as soft segment and isophorane diisocyanate (IPDI) and 1,4 cis-2-Butene-1,4-diol (Cis-BDO) as hard segments. This TPU was synthesized by conventional prepolymer route and contains 30wt% of hard segment. Diol chain extender (Cis-BDO) has carbon-carbon double bond that could take part in curing process. TPU solution was mixed with 1,6-Hexanediol diacrylate (HDDA) as diluent monomer (10wt%), Benzophenone as initiator (3 wt%) and N-Methyldiethanolamine as accelerator (3 wt%) in room temperature. After solvent evaporation, in order to cure the film, it was exposed to UV irradiation (365 nm). Graftings are made by crosslinking carbon-carbon double bonds of Cis-BDO to c=c bonds of HDDA monomers. Flexibility of initial TPU was not changed considerably by examining different conditions such as choosing various primary materials and also changing the content of curing. Also for comparison with this PU, UV curable polyurethane acrylate was synthesized with similar structure that was composed of PTMG, IPDI, 2-hydroxyethyl methacrylate (HEMA) and HDDA. To investigation the structure and mechanical properties, FTIR, GPC, Hardness and Tensile tests were done.

Comparison of mechanical properties of these three types of PUs reveals that elongation at break of TPU is much higher than UV-cured TPU and UV-cured TPU is higher than UV-cured acrylated PU. This can be attributed to high degree of crosslinkings that occur by UV radiation. A significant amount of flexibility of TPU was retained in UV-cured TPU but acrylated ones were not flexible at all. Tensile set even after the 10 min retraction period was zero in UV-cured TPU unlike TPU that shows permanent residual set. Thus for applications that the PU film must be high flexible, strained up to 200% and has very low tension set, such as dielectric elastomer actuator, this UV-curable TPU seems to be very suitable.