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EFFECT OF VARIOUS SOLVENTS ON THE STRESS
INDUCED BIREFRINGENCE OF PMMA.//

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THE EFFECT OF VARIOUS SOLVENTS ON THE STRESS-INDUCED
BIREFRINGENCE OF POLY(METHYL METHACRYLATE)

Abstract:

The orientation and structural changes, resulting from the application of known compressive stresses in Poly(methyl methacrylate) samples conditioned in acetonitrile, n-butanol, methanol, ethylene glycol and ethanol at room temperature, have been investigated by measuring the optical double refraction or birefringence induced by the stresses. The birefringence values were obtained from the analysis of photoelastic interference fringes using a polariscope.

For samples conditioned in acetonitrile, methanol and ethanol, the stress-optical coefficient increased with duration of conditioning, although ethanol conditioning had a much smaller influence over the same period of time. The stress optical coefficient decreased with duration of conditioning in n-butanol and ethylene glycol.

These results have been explained on the basis of creation of free volume and increased chain flexibility which allow the polymer chains to assume preferred chain conformations in response to applied stress in the case of acetonitrile, methanol and ethanol conditioning. Increased

rigidity as a result of desorption of residual moisture and possibly monomer units and hence increased interaction of polymer chains have been used to explain the reduction of the stress-optical sensitivity for poly(methyl methacrylate) conditioned in n-butanol and ethylene glycol.

The results also show that the refractive index and the density of the polymer decreased with duration of conditioning in all the solvents used. The molecular polarizability anisotropies calculated from the stress-optical coefficient values, show an increase with duration, for samples conditioned in acetonitrile, methanol and ethanol, while they decrease with duration of conditioning in n-butanol and ethylene glycol.

Acetonitrile which has a cohesive energy density close to that of poly(methyl methacrylate) and which is weakly hydrogen bonded showed the greatest effect.