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Mounting Media for the Microscopical Examination of Rubber-Reinforced Polymers

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Synopsis

Mounting media for examining rubber reinforced copolymers using the phase microscope are described. The mounting media are based on cinnamaldehyde as the basic solvent with suitable adjustments made depending upon the copolymer under examination.

Introduction

Several workers have reported information that can be obtained through examination of the rubber in reinforced polymers.[1-3] Only a few articles have discussed the mounting techniques used in microscopical examinations of polymers. In a previous paper the authors reviewed the published methods and described a method of employing a selective solubility type mount for use with rubber-reinforced polystyrene.[4] The purpose of this paper is to describe the use of a series of mounting media in the microscopical examination of rubber-reinforced copolymers and alloys presently in common use. The series of mounts is based on four laboratory reagents: cinnamaldehyde, poly(methyl methacrylate), butylcarbitol, and ethyl vanillin. The basic solvent in our series is cinnamaldehyde, which has been used previously in dispersion staining microscopy.[5] Cinnamaldehyde displays selective solubility toward the following rubber-reinforced polymers: polystyrene, acrylonitrile–butadiene–styrene polymer (ABS), polyacrylates, poly(phenylene oxide) (PPO). The PPO alloy is soluble to only a limited extent.

Butylcarbitol is used to adjust the mount refractive index to suit the material under examination.[5] The ethyl vanillin and poly(methyl methacrylate) are used to produce practical viscosities in the mounting medium for photomicrographic purposes. We describe the mounting procedures for three of the rubber-reinforced polymers below.

Rubber-Reinforced Polystyrene

In mounting this polymer, cinnamaldehyde alone does the best job, suitable mount viscosity being produced as the section dissolves. A hot plate is maintained at a temperature of 200–250°F near the sample preparation

area. A hand-sliced section or wedge of polymer is adequate, since the solvent property of the mounting medium produces the thin, flat section, not the microtoming. This section is mounted in a drop of cinnamaldehyde and heated for approximately 30 sec or until the section relaxes completely. A cover slip is then placed on the drop of mounting medium and allowed to settle in place. Slight pressure from a needle or glass rod will aid spreading of section and produces a thin, flat mount with only the reinforcing material visible under the phase microscope. Figure 1 shows the photomicrographic results obtained by this method.

We previously described a mounting medium based on a styrene–polystyrene solution which gives equivalent results to the cinnamaldehyde mount.[4] However, the styrene–polystyrene mount is specific for rubber-reinforced polystyrene while the cinnamaldehyde is useful for mounting other copolymers as described below.

ABS Polymers

In mounting ABS materials, it is usually desirable to increase the mount viscosity due to the usually very small rubber particles present. Visual observation is not hampered when pure cinnamaldehyde is used, but Brownian motion of the very small particles makes photomicrography very difficult with normal tungsten illumination on the phase microscope. Because photomicrographs are normally the desired end product in this type of examination, a saturated solution of poly(methyl methacrylate) in cinnamaldehyde is employed. A water bath held at about 150 degrees F is used to put the poly(methyl methacrylate) into solution. By using the

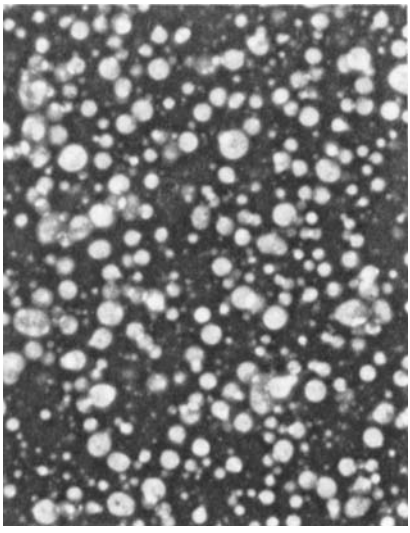

Fig. 1. Photomicrograph of rubber reinforced polystyrene. 500×.

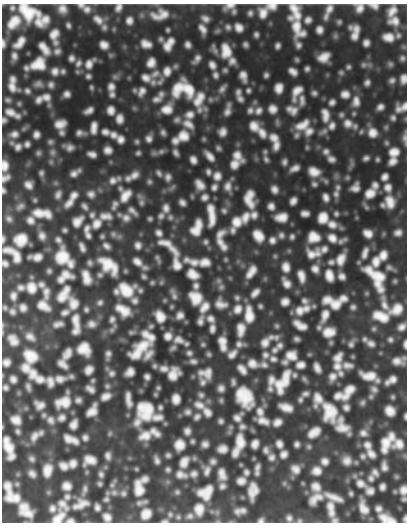

Fig. 2. Photomicrograph of acrylonitrile–butadiene–styrene polymer. 500×.

same procedure as for rubber-reinforced polystyrene but with more viscous mounting medium, excellent photomicrographs can be obtained. Figure 2 shows a typical photomicrograph of ABS obtained with this mount.

Rubber-Reinforced Polyacrylates

Again, the same basic mounting procedure is employed but with one additional step. Due to the low refractive index of some polyacrylates, the

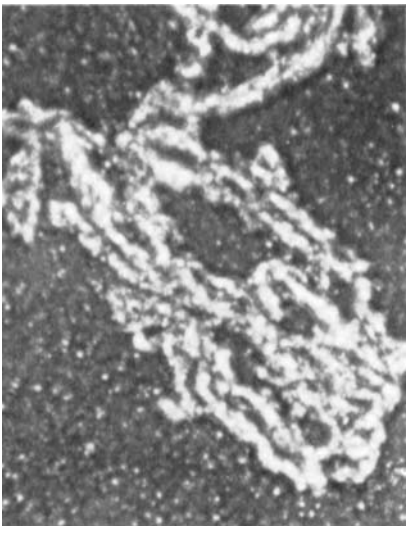

Fig. 3. Photomicrograph of rubber-reinforced polystyrene. 500×.

refractive index of the mounting medium must be lowered to prevent glare in the section during examination under the phase microscope. Butylcarbitol is added to the mounting medium until optimum phase contrast is obtained and interior details of the rubber particles are visible. Figure 3 illustrates the results obtained by using this method.

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