NOTES

Photoinitiated Polymeric Encapsulation of Cotton Fibers

Harris et al.[1] reported unsensitized photoinitiated polymerization of vinyl monomers with cotton cellulose. Cotton was totally immersed in solutions of the monomers during photoirradiation. Transmission electron photomicrographs of cross sections of the treated fibers showed that encapsulation of the fibers occurred at poly(glycidyl methacrylate) (pGMA) add-ons of 22% to 69%. This note deals with an extension of this work to pGMA add-ons as low as 4.2% and also reports data that show encapsulation of the fiber and the extent of covalent interaction of pGMA with cotton cellulose.

EXPERIMENTAL

The materials, chemical reagents, and methods of photoinitiated polymerization were as previously described.[1] The encapsulation of the fibers by pGMA was determined by transmission electron-microscopic examination of ultrathin cross sections.[2] The extent of covalent interaction of pGMA with cotton cellulose was determined by immersing ultrathin cross sections of the treated fibers in 0.5*M* cupriethylenediamine dihydroxide (CED) and by observing the degree of dissolution of the treated fibers, as previously described.[3,4]

RESULTS AND DISCUSSION

The preparation of some photoinitiated copolymers of pGMA with cotton cellulose is described in Table I. The solvent system (43% water, 57% methanol, v/v) was the optimum composition of solvent from which to photoinitiate polymerization of glycidyl methacrylate (GMA) with cotton cellulose.[1] When either the concentration of GMA in the solution or the dosage was increased, the add-on percentage of pGMA increased.

Encapsulation and interaction of the fibers with photoinitiated polymerized pGMA are shown in Figures 1, 2, and 3. Encapsulation of the fibers with pGMA occurred at add-ons ranging from 4.2% to 69%. The thickness of the encapsulation layer seemed to be independent of pGMA add-on, Figures 1(a), 1(c), 1(e), 2(a), 2(c), and 3(a). The extent of interaction of pGMA with cellulose seemed

TABLE I
Photoinitiated Polymerization of Glycidyl Methacrylate with Cotton Cellulose[a]

GMA[b] concentration, vol %	Ultraviolet radiation		pGMA,[c] % add-on	TEM[d]
	Wavelength, nm	Dosage, kJ		
1.0	350	49	4.2	Fig. 1 (a),(b)
1.5	350	49	6.6	Fig. 1 (c),(d)
3.0	350	49	18	Fig. 1 (e),(f)
7.5	350	43	32	Fig. 2 (a),(b)
7.5	350	86	69	Fig. 2 (c),(d)
7.5	254	63	22	Fig. 3 (a),(b)

[a] Solvent system: 43% water, 57% methanol (v/v).
[b] GMA = glycidyl methacrylate.
[c] pGMA = poly(glycidyl methacrylate).
[d] TEM = transmission electron microscopy.

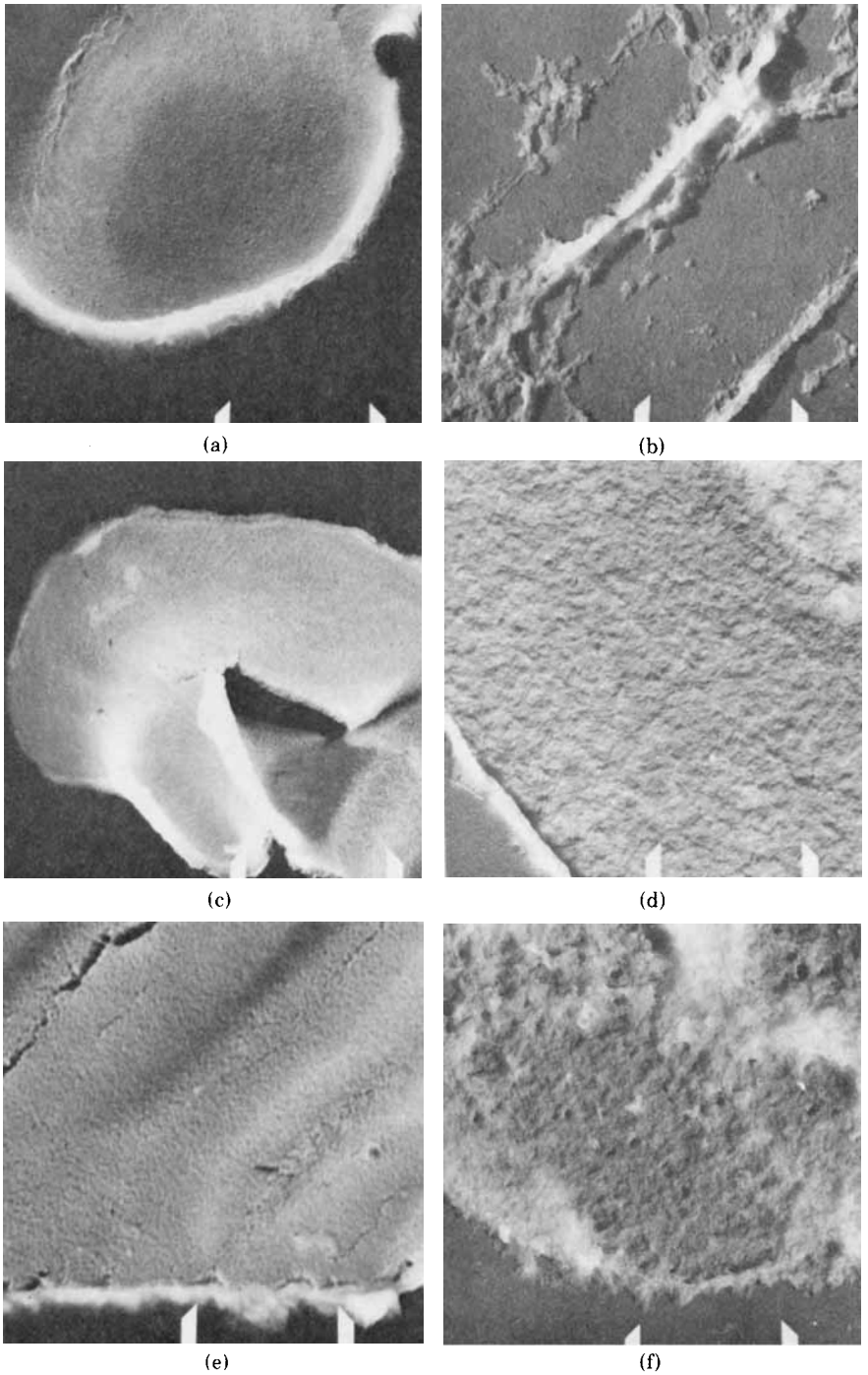


Fig. 1. Transmission electron-microscopic sections of cotton fibers from printcloth treated with poly(glycidyl methacrylate) (pGMA): (a) section of fiber treated with pGMA (4.2% add-on); (b) section (a) immersed in 0.5*M* cupriethylenediamine dihydroxide (CED) for 1.8 ksec; (c) section of fiber treated with pGMA (6.6% add-on); (d) section (c) immersed in 0.5*M* CED for 1.8 ksec; (e) section of fiber treated with pGMA (18% add-on); (f) section (e) immersed in 0.5*M* CED for 1.8 ksec. Distance between markers = 1 μm.

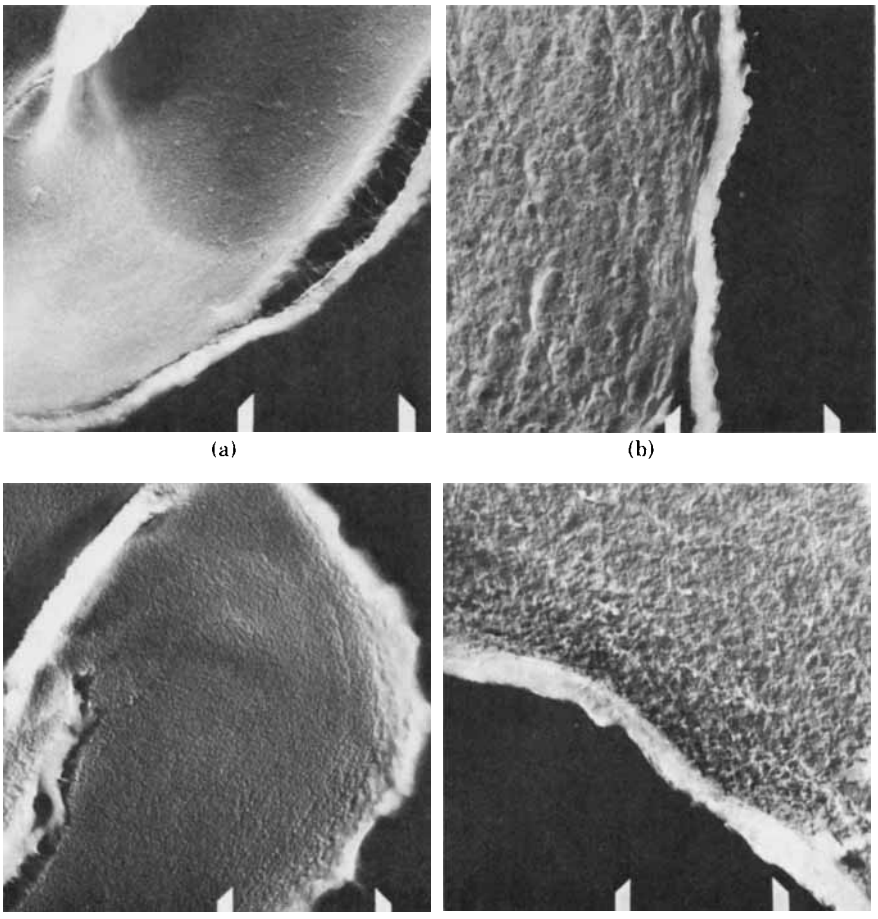
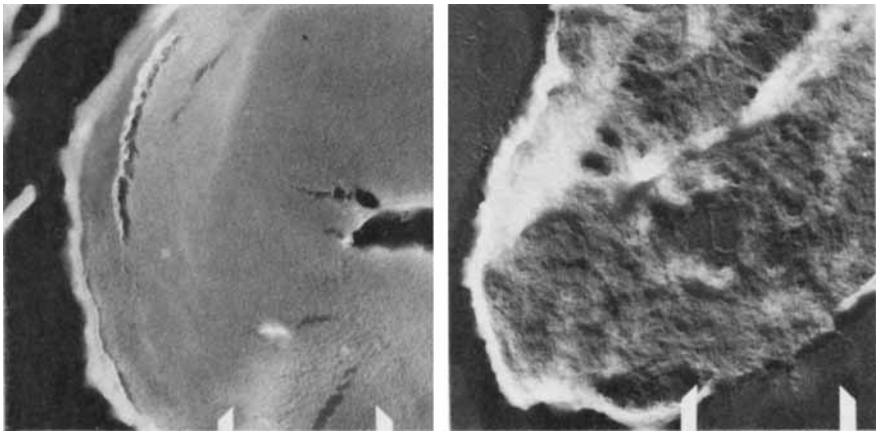


Fig. 2. Transmission electron-microscopic sections of cotton fibers from printcloth treated with poly(glycidyl methacrylate) (pGMA): (a) section of fiber treated with pGMA (32% add-on); (b) section (a) immersed in 0.5*M* cupriethylenediamine dihydroxide (CED) for 1.8 ksec; (c) section of fiber treated with pGMA (69% add-on); (d) section (c) immersed in 0.5*M* CED for 1.8 ksec. Distance between markers = 1 μm.

to depend on add-on. At the lowest pGMA add-on, Figure 1(b), dissolution of the fiber occurred when it is immersed in 0.5*M* cupriethylenediamine dihydroxide (CED). However, at higher pGMA add-ons, Figures 1(d), 1(f), 2(b), 2(d), and 3(b), interaction between pGMA and cellulose increased, so that dissolution of the fiber did not occur when it was immersed in 0.5*M* CED. The effects of light on pGMA add-on were reported to be much greater for 254-nm light than for 350-nm light.[5] However, encapsulated fibers that contained about the same amount of pGMA and were prepared with 350-nm light, Figures 1(e) and 1(f), were similar to fibers prepared with 254-nm light, Figures 3(a) and 3(b).

Encapsulated cotton fibers were prepared by photoinitiated polymerization of GMA. Useful applications of pGMA-modified cottons with pendent oxirane groups include increased dyeability of cotton[6] and reaction of the groups with cellulose to give crosslinkages and wrinkle-resistant cotton fabrics.[5]



(a) (b)

Fig. 3. Transmission electron-microscopic sections of cotton fibers from printcloth treated with poly(glycidyl methacrylate) (pGMA): (a) section of fiber treated with pGMA (22% add-on); (b) section (a) immersed in 0.5*M* cupriethylenediamine dihydroxide for 1.8 ksec. Distance between markers = 1 μm.

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