

# **SWELLABLE FILM FORMING COMPOSITIONS AND METHODS OF NANOIMPRINT LITHOGRAPHY EMPLOYING SAME**

## **FIELD**

The present disclosure relates to film compositions capable of being swelled by the application of solvent, conveniently water. The present disclosure further provides methods for patterning surfaces using these compositions.

## **BACKGROUND**

Nanoimprint lithography encompasses methods of fabricating nanometer scale features onto a substrate. Known methods include those where the features are embossed, and those where the features are micro replicated. When micro-replication is pursued, it is known to employ a UV curable liquid resist for forming patterned conductive traces on the substrate. In the next step, the material at the bottom of the recessed features formed from the resist is etched away to expose the substrate. Subsequently, a metal layer is then deposited that covers the tops of the non-recessed patterned features as well as the exposed substrate. After the metal has been applied, it is necessary to remove (lift-off) the unneeded resist and metal overlay remaining on the substrate. This material is typically removed by selective etching, or washing in an organic solvent.

## **SUMMARY**

The present disclosure provides unique UV curable acrylic resin compositions that can be coated using cast and cure techniques to yield microreplicated acrylic films on, e.g., a polyester substrate. These microreplicated films can be etched and metalized to give a patterned film, and finally the non-metalized excess acrylic film and over coated metal can be subsequently removed from the substrate using only a hot water wash, leaving a nano scale patterned film.

Thus, in one aspect, the present disclosure provides a composition of matter, comprising: a UV curable polymer precursor comprising a first acrylate selected as a mono-alkoxy polyalkylene glycol acrylate, a second acrylate selected as a mono-, di-, or tri-acrylate, and between 0.1 to 2.5 parts by weight of a photoinitiator. One example of such

## CLAIMS

1. A method of forming a predetermined metalized pattern on a substrate, comprising:  
casting and curing a polymerizable precursor into a first side of the substrate so as to  
5 form a water swellable acrylic layer on the substrate, the water swellable acrylic layer  
having thick portions and thin portions such that the thin portions correspond to the  
predetermined pattern;

etching the water swellable acrylic layer so that the thin portions are removed and  
substrate is partially exposed;

10 metalizing the first side so as to deposit metal onto the exposed portions of the  
substrate and onto the thick portions of the water swellable acrylic layer; and

exposing the water swellable acrylic layer to water, releasing the water swellable  
acrylic layer and its over-coat of metal from the substrate and leaving the substrate with  
the predetermined metalized pattern.

15 2. The method according to claim 1 wherein the water swellable acrylic layer is at least  
0.3 microns in thickness.

20 3. The method according to claim 1 wherein the polymerizable precursor comprises a first  
acrylate selected as a mono-alkoxy polyakylene glycol acrylate, a second acrylate selected  
as a mono-, di-, or tri-acrylate, and between 0.1 to 2.5 parts by weight of a photoinitiator.

25 4. The method according to claim 1 wherein the polymerizable precursor comprises a  
liquid, monomeric, acrylic resin.

5. The method according to claim 1 wherein the viscosity of the polymerizable precursor  
is less than 5000 centiPoise.

6. A composition of matter, comprising:  
a UV curable polymer precursor comprising  
a first acrylate selected as a mono-alkoxy polyakylene glycol acrylate,  
a second acrylate selected as a mono-, di-, or tri-acrylate, and  
5 between 0.1 to 2.5 parts by weight of a photoinitiator.
7. The composition of matter according to claim 6 wherein the mono- or di-acrylate is  
selected from the group consisting of polyalkylene glycol diacrylate monomer, hydroxy  
alkyl mono acrylate, and ethoxylated Bisphenol A diacrylate.  
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8. The composition of matter according to claim 7 wherein the polyalkylene glycol  
diacrylate monomer is polyethylene glycol 400 diacrylate.
9. The composition of matter according to claim 7 wherein the hydroxy alkyl mono  
15 acrylate is hydroxy ethyl acrylate.
10. The composition of matter according to claim 6 wherein the mono-alkoxy  
polyakylene glycol acrylate has a molecular weight above 500 Daltons.
- 20 11. A water swellable acrylic polymer formed by UV polymerization of the composition  
of matter of claim 6.