

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

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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.

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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.

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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.

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Thus, in one aspect, the present disclosure provides a composition of matter, comprising: a UV curable polymer precursor comprising between about 30 to 95 parts by weight of a mono-alkoxy polyalkylene glycol acrylate, between about 5 to 65 parts by weight of mono-, di-, or tri-acrylate, and between about 0.1 to 2.5 parts by weight of a photoinitiator. One example of such

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a mono-, di-, or tri-acrylate monomer would be a polyalkylene glycol diacrylate monomer such as polyethylene glycol 400 diacrylate, another would be a hydroxy alkyl mono acrylate such as hydroxy ethyl acrylate, still another would be an ethoxylated Bisphenol A diacrylate. These compositions are readily cast and cured on convenient substrates, and yet the polymerized film will swell and lift off from those substrates when desired by means of a simple water wash.

In some embodiments, the mono-alkoxy polyalkylene glycol monoacrylate has a molecular weight of above 500 Daltons.

In another aspect, the present disclosure provides a water swellable acrylic polymer formed by UV polymerization of the composition of matter just described.

In another embodiment, the present disclosure provides 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 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; 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. It has been noted that best results with respect to lift-off are achieved when the water swellable acrylic layer is not too thin, with a thickness of at least about 0.3 microns being considered suitable, or even 1 micron, or even 3 microns.

Various aspects and advantages of exemplary embodiments of the present disclosure have been summarized. The above Summary is not intended to describe each illustrated embodiment or every implementation of the present disclosure. Further features and advantages are disclosed in the embodiments that follow. The Drawings and the Detailed Description that follow more particularly exemplify certain embodiments using the principles disclosed herein.