A composite imprint lithography technique for the mass production of large-area microstructures

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Large-area nanopatterning has demonstrated great potential to enhance devices performance and create innovative products, such as LEDs, OLED, solar cells, hard disk drives, laser diodes, displays, sub-wavelength optical elements, etc. However, most of the existing fabrication approaches for micro/nano-structures are still facing difficulties for the large-area patterning on uneven rigid substrates and fragile substrates. In this paper, a new process of composite micro/nanoimprint lithography for mass fabricating large-area microstructures is presented. This technology combines advantages of the roller-type imprint and the plate-type imprint to implement the "progressive" line-contact pressure and the “open-type” mold releasing on the uneven rigid and fragile substrates through the coordination work of the roller, working platform, soft mould, ultraviolet light source, and auxiliary air pressure, ensuring the large area of imprinted micro/nano patterns with high precision and high quality. Through research and optimizing the effects of process parameters (spreading speed of the flexible mold, imprint force and imprint speed as well as curing time) on imprinted micro/nano patterns, this technology was applied to fabricate large-area micro/nanostructures on three different rigid substrates (glass, PMMA and sapphire), including microscale columnar structures (the largest pattern area is 132×119 mm), microscale grating structure (the largest area is 6 inch round) and nanoscale columnar structure (graphic area is 47mm×47mm). As a result, the presented composite imprint lithography technique provides a fire-new way to the macroscopic quantity preparation of large-area micro/nanostructures and large-area patterning on rigid or fragile substrates, and exhibit a bright prospect for industrial applications.

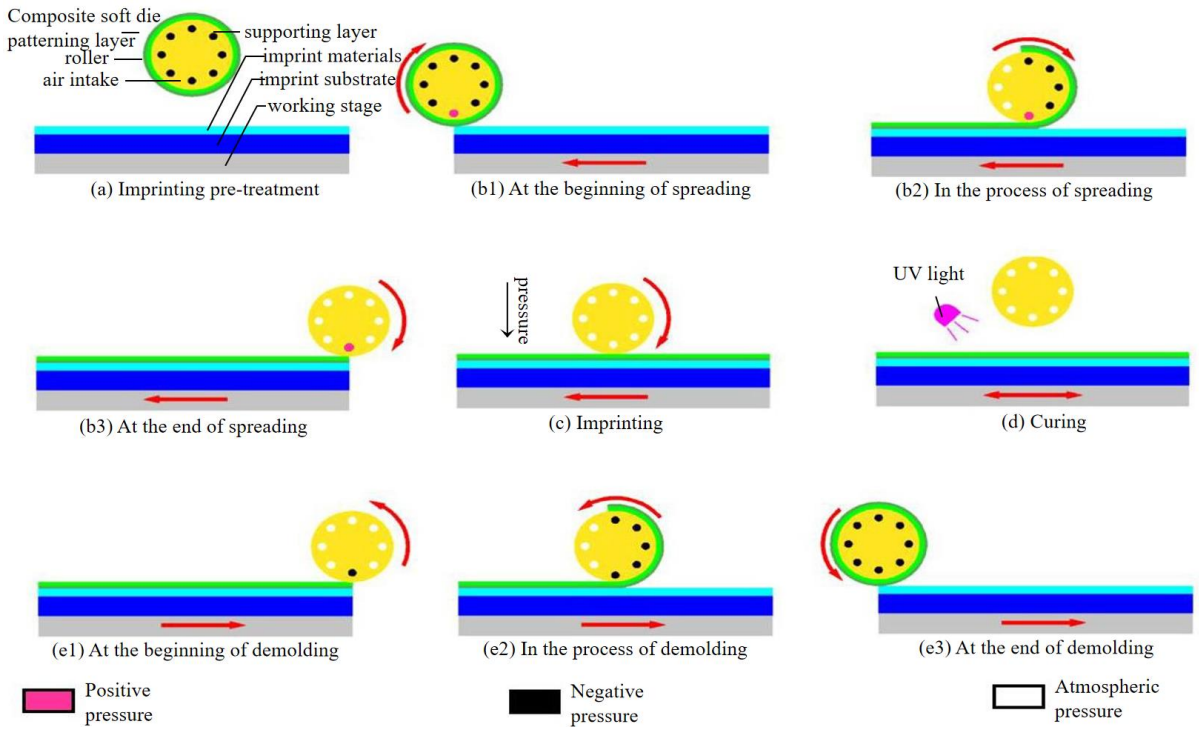

Figure 1. Workflow chart of composite imprint lithography

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