Extending the capability of lithography with mechanical processes

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Abstract

Resist-based micro/nanoscale patterning techniques are essential to modern micro/nanoscale science and technology. A standard resist patterning process is associated with selective-area scission or crosslinking of resist molecules under the exposure of energy beams. Such standard process has limits when being used in electron-beam lithography and focused-ion beam patterning considering the low throughput and the proximity effect. In addition, specific polymeric films that are sensitive to energy beams and can be selectively removed via solvents have to be used as resists, leading to limited capability of lithographic processes for patterning amount of functional materials due to the process compatibility. Such limits become more apparent when being applied to flexible and stretchable devices. In this work, we share our progress on extending the capability of lithography with mechanical processes, including peeling, transfer printing, controllable fracture and post assembly. We demonstrate that various functional patterns and devices that are impossible or difficult to fabricate using existing lithographic processes can be readily achieved with improved throughput and precision by combining mechanical processes, suggesting the complementary ability of mechanical approaches to standard lithography processes.

Biography

Huigao Duan received his BS and PhD in Physics from Lanzhou University (China) in 2004 and 2010, respectively. From 2006 to 2008, he was working as a Researcher in Institute of Electrical Engineering, Chinese Academy of Sciences. From 2008 to 2012, he was a visiting student at Massachusetts Institute of Technology and then a Research Scientist in Institute of Materials Research and Engineering, A*STAR (Singapore). He was also a visiting scientist in University of Stuttgart in 2012, hosted by Prof. Harald Giessen. He joint Hunan University as a full professor in 2012 and then setup a micro/nanofabrication laboratory there. He has authored or co-authored more than 170 peer-reviewed journal papers with citations more than 7800 times and an H-index of 45 (Google Scholar). His current research interests include sub-10-nm patterning, high-resolution color printing, nanomanufacturing, smart micro/nanosystems and their relevant applications. He has served as Associate Editors for several journals including Research (a Science Partner Journal), IEEE Transactions on Nanotechnology, Microelectronic Engineering, and International Journal of Extreme Manufacturing.