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Patterning self-assembled pentacene nanolayer by EUV-induced 3-dimensional polymerization

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Extreme ultraviolet lithography (EUVL) is expected to be applied for making patterns below 32 nm in device industry. An ultrathin EUV photoresist (PR) of a few nm in thickness is required to reduce minimum feature size further. Here, we show that pentacene molecular layers can be employed as a new EUV resist for the first time. Dots and lines in nm scale are successfully realized using the new molecular resist. We clearly provide the mechanism for forming the nanopatterns with scanning photoemission microscope (SPEM), EUV interference lithography (EUV-IL), atomic force microscope (AFM), photoemission spectroscopy (PES), etc. The molecular PR has several advantages over traditional polymer EUV PRs; for example, high thermal/chemical stability, negligible outgassing, ability to control the height and width on the nanometer scale, leaving fewer residuals, no need for a chemical development process and thus reduction of chemical waste to make the nanopatterns. Besides, it could be applied to any substrate to which pentacene bonds chemically, such as SiO_2, SiN, and SiON, which is of importance in the device industry.