Laser and Reactive Ion Etching Assisted Nanosphere Lithography Technique (LARIE NSL): Fabrication of Carbonaceous Nanoparticle Arrays


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Nanosphere Lithography technique (NSL) used self-assemble Polystyrene Nanospheres (PSN) as lithography mask, where the voids between the self assembled nanospheres can be used to direct patterning metal particles or used as reactive ion etching mask. Polystyrene can act as polymer resist and recently we found out that it can be turned into carbonaceous nanoparticles or graphite nanodots by LASER treatment. Confirmation of the structural changes of the polystyrene nanospheres were done using FTIR and XPS analysis, confirming the modification of the irradiated polystyrene structures which are affected by laser irradiation and were later found to be resistant toward Ar-Oxygen plasma treatment. The fluctuating of formation and deformation of C=C bonding can be traced in the XPS spectrums indicating the zwitter characteristic of overexposure polymer resists such as polystyrene to laser irradiation, could be due to the fluctuation formation of C=C bonding in the irradiated polystyrene nanospheres.

References

[1] X Chen, X Wei, K Jiang, Nanotechnology Vol. 20(2009), 425605

Figures

Figure 1 (a-f) are the series of irradiated polystyrene nanospheres (PSN) images of different dosages of laser irradiation and later etched with Ar-Oxygen(ratio 2:1, 20 s). Averages of irradiated PSN diameter after etching are ranging from 300nm-334nm.Original size PSN 500nm.
Figure 2: Convoluted XPS data of 2(a) original PSN, 500 nm in diameter and 2(b) irradiated PSN (laser expose duration of 50 minutes) and later etched Ar-Oxygen plasma (2:1, 20 s).

Figure 3: Summarized of the chemical properties changes of irradiated polystyrene nanospheres with laser exposure range from (0-60*minutes) and Ar-Oxygen plasma treatment (2:1, 20s), that shows the possibilities of zwitter characteristic phenomena of overexposure of polymer resist to radiation source.