NanoFabrication of Thin Films with Light Ions Beams

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The introduction of newly available ion beam technologies and their available ion species has allowed researchers to explore novel ion beams for various applications. One of the key factors to consider is the physics of sample interaction, which is mostly dependent upon the mass of the ion species. In this regard, light ion beams offer unique advantages, especially for thin films, compared to conventional ion beams such as gallium.

There are various advantages of light ions (e.g. H, He, Li, Ne) for thin films (< 200 nm thick), but they all stem from the lower mass. For the typical beam energies (10 to 30 keV), the overall stopping power in eV/nm for light ions is considerably less than the corresponding values for Ga or Xe. Consequently, the light ions pass right through many materials while heavier species will be implanted and can cause adverse effects. The lighter ion beams stay relatively collimated as they enter the sample and interact primarily with electrons, so they are well suited for resist lithography, beam chemistry, and for imaging – all applications where electron interactions are key. In addition, the nuclear stopping power of light ions can be two decades lower as compared to gallium, meaning any desired damage (e.g. sputtering or dislocations) can be carried out at a slower rate, enabling higher precision with the ability to monitor and control the dosage. Finally, the temperature rise of the sample through the usage of light ion beams is considerably reduced due to lower imputed energy densities, an advantage for many polymers and biomaterials. Simulations and experimental results with light ion beams will be shown.