Effects of the Conducting Grid and Supporting Cage on Plasma Implantation of Non-Conductive Materials

Ricky K. Y. Fu, Xiubo Tian, and Paul K. Chu

Dept. of Physics & Materials Science, City University of Hong Kong, Tat Chee Avenue, Kowloon, Hong Kong

Previous studies on plasma implantation insulators covered with a conducting grid show that the implantation energy can be enhanced due to the pre-acceleration of incident ions and the reduction of the capacitive effect of the dielectric materials. A cage made of stainless steel or other compatible materials (avoiding contamination) is used to support the conducting grid so as to entirely shield the insulator, and it is negatively pulse-biased to build up an equipotential space between the insulator top surface and the grid. It is believed that the low-energy secondary electrons induced by the incident ions and emitted from the surface are retracted back to the insulator surface to moderate the accumulated charge. In this work, we carry out experiments in which dielectric materials are plasma implanted with a conducting grid. Two approaches are adopted. One of the insulators is totally enshrouded by the conducting grid with a supporting cage and the other one is treated under the grid placed at a specific distance above the sample surface. In the both cases, the conducting grid or the supporting cage has the same bias potential as the sample stage. The implanted materials are characterized using secondary ion mass spectrometry (SIMS) to compare the efficacy of the different processes and the results are modeled using theoretical simulation to fathom the mechanisms.