Ion beam lithography: resist modification volume determination and sub-10nm resolution prediction via simulation.

Yana L. Shabelnikova*, Sergey I. Zaitsev

Institute of microelectronics technology and high purity materials RAS, Chernogolovka, Russia

ABSTRACT

Ion beam lithography (IBL) employing sensitive resist modification by ion beam has a big potential for nanostructuring. But at present for various reasons it is insignificant in comparison to the position of the electron beam lithography (EBL) in spite of IBL has certain advantages. One of them is the fact that during irradiation of the resist energy of heavy ions deposits in a very small volume. In order to estimate the size of modified resist volume (and so resolution achievable) we had modeled the distribution of energy deposited by ion beam. The lateral size of the deposited energy volume in the case of heavy ions was found to be of the order of ten nanometers. Based on the results of modeling the analytical description was proposed for the function of deposited energy spatial distribution. This description is the product of two Gaussian functions, one of that describes the radial energy distribution and the other refers to the in-depth dependence. The centers and dispersions of these Gaussian functions are determined by the energy length and atomic mass of ions in the resist. The proposed analytical description allow to assess the resist modified volume size for all types of heavy ions with energies of tens keV and for light resists. It can be used for a priori estimates of the resolution and efficiency, as well as for selection of ion-resist pairs.