투과전자현미경을 이용한 n+/p접합에서 불순물의 이차원적 분포에 관한 연구

A transmission electron microscope study of two-dimensional dopant profiling in n+/p junctions

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Transmission electron microscopy (TEM) combined with selective chemical etching was used to assess two-dimensional (2D) dopant profiles in n+/p junctions where arsenic implantation was performed for various conditions; energy ranging from 35 to 100 keV with dose of $2x10^{13}$ and $1x10^{14}$ cm^{-2}. The selective chemical etching results in the local variations in crystal thickness giving rise to the appearance of thickness fringes. Such fringes can be interpreted as 2D iso-concentration contours that map the dopant distribution. Thickness fringes corresponding to a concentration of $6x10^{16}$ cm^{-3} can be observed with accuracy less than 10nm. It is shown that the chemically delineated junction depth increases gradually with increasing implantation energy and dose. The TEM results show that crystallographic defects hamper the doping-dependent etching process in the n-type semiconductor. The SUPREM-IV simulated lateral dopant profiles of the experimental conditions are compared with the TEM results calibrated using SIMS. The delineation technique is effectively applied to characterise metal-oxide-semiconductor (MOS) devices.