The Features of Cleavages in Au–Ti–Pd–n^+–n-Si Ohmic Contacts

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Here we present the results of investigation of cleavages of both n^+–n-Si structures and Au–Ti–Pd–n^+–n-Si contacts before and after thermal treatment at a temperature $T = 450$°C for 20 min. The heavily doped n^+-Si layers were obtained using phosphorus ion implantation. The n^+-Si layer thickness was ~65 nm, the dopant concentration was ~10^{20} cm^{-3}. The phosphorus ions were implanted using the "Vesuvius-5" installation. The ion energy was ~60 keV, the implanted dose was ~10^3 μC·cm^{-2}. Thermal annealing of the implanted specimens was made in the oxygen atmosphere at $T = 850$°C for 30 min using a SDOM 3/100 unit. The Au–Ti–Pd–n^+–n-Si contacts were prepared by successive metal evaporation in a vacuum onto the n^+–n-Si structure heated to 350°C. Ohmic contacts were formed in the course of metal evaporation. The cleavage surfaces in the n^+–n-Si and metallized n^+–n-Si structures were studied before and after annealing using a high resolution scanning electron microscope S-4800. The elemental composition of contact metallization was determined using an energy dispersive spectrometer QUANTEX 200 (Bruker, Germany).

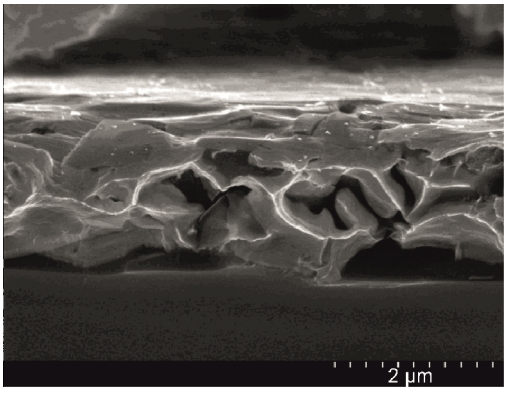

Fig. 1

It was found that, after annealing of ion-implanted n^+-Si layer, the cleavages of the n^+–n-Si structure did not contain any amount of structural defects. After evaporation of contact metallization onto a heated substrate, the degree of imperfection of the near-contact Si layer was bigger than that of the non-metallized n^+–n-Si structure. However, no considerable smearing of the metal–n^+-Si interface was observed.

The morphology of Au–Ti–Pd–n^+–n-Si cleavage changed drastically after annealing at $T = 450$°C for 20 min. (Fig. 1). Through pores in the contact metallization disturb continuity of the contact-forming layer. Such disturbances of contact metallization may change mechanism of current flow in ohmic contacts. In this case, contact resistivity may increase with temperature which leads to deterioration of parameters of semiconductor devices.