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Thermal stability of titanium nitride layers synthesized by thermal-ion reactive technique

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Thermal stability of TiN_x films deposited by thermal-ion reactive technique onto the n^+-Si substrate and Pd_2Si–n^+-Si structure has been investigated. Static I–V curves for diode structures were measured both prior to and after rapid (60 s) thermal annealing in H_2 atmosphere at T = 400, 600 and 800°C. After heat treatment for 10 min. in vacuum at T = 600 and 800°C, structural properties of TiN_x films and microhardness were examined for samples of both types. The TiN_x films grown on n^+-Si substrate and TiN_x–n-n^+-Si diode structures retain thermal stability up to 800°C and better structural perfection than the TiN_x layers grown on the Pd_2Si–n^+-Si structures. Physical reasons for such effects are discussed.

Исследована термостабильность пленок TiN_x, осажденных термоионным реактивным методом на подложку n^+-Si и на структуру Pd_2Si– n^+-Si. До и после быстрых (60 с) термических отжигов в атмосфере H_2 при T = 400, 600 и 800°C измерялись статические вольтамперные характеристики диодных структур, а после термообработок продолжительностью 10 мин. в вакууме при T = 600 и 800°C на образцах обоих типов были исследованы структурные свойства пленок TiN_x и микротвердость. Пленки TiN_x, выращенные на подложке n^+-Si, и диодные структуры TiN_x –n-n^+-Si оказались термостабильными до температуры 800°C и более структурно-совершенными, чем слои TiN_x, выращенные на структурах Pd_2Si–n^+-Si. Обсуждаются физические причины подобных эффектов.

For many years the specialists engaged in technology of contacts have been taking an active interest in the Schottky barrier diodes and ohmic contacts to nitrides and borides of refractory metals [1–4]. Titanium nitride is most extensively studied in this area. Various versions of its thin film preparation technology are well developed, and the properties of this object have been studied rather well. This interest is motivated, first of all, by high chemical inertness of titanium nitride to semiconductors: no chemical reactions occur at temperatures from the operating temperature range and even at higher ones.

However, along with such promising features, these films most often demonstrate structural-phase inhomogeneity. Its elimination makes a complicated physico-technological problem, solution thereof could provide further progress in manufacturing technology of semiconductor devices. Therefore, the objective of this work was thermal stability investigation of titanium nitride