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Nickel Silicide Nanowire Growth and Applications

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The silicide is a compound of Si with an electropositive component. Silicides are commonly used in silicon-based microelectronics to reduce resistivity of gate and local interconnect metallization. The popular silicide candidates, CoSi2 and TiSi2, have some limitations. TiSi2 showed line width dependent sheet resistance and has difficulty in transformation of the C49 phase to the low resistive C54. CoSi2 consumes more Si than TiSi2. Nickel silicide is a promising material to substitute for those silicide materials providing several advantages; low resistivity, lower Si consumption and lower formation temperature. Nickel silicide (NiSi) nanowire (NW) has features of a geometrically tiny size in terms of diameter and significantly long directional length, with an excellent electrical conductivity. According to these advantages, NiSi NWs have been applied to various nanoscale applications, such as interconnects [1,2], field emitters [3], and functional microscopy tips [4]. Beside its tiny geometric feature, NW can provide a large surface area at a fixed volume. This makes the material viable for photovoltaic architecture, allowing it to be used to enhance the light-active region [5]. Additionally, a recent report has suggested that an effective antireflection coating-layer can be made with by NiSi NW arrays [6]. A unique growth mechanism of nickel silicide (NiSi) nanowires (NWs) was thermodynamically investigated. The reaction between Ni and Si primarily determines NiSi phases according to the deposition condition. Optimum growth conditions were found at 375^{o}C leading long and high-density NiSi NWs. The ignition of NiSi NWs is determined by the grain size due to the nucleation limited silicide reaction. A successive Ni diffusion through a silicide layer was traced from a NW grown sample. Otherwise Ni-rich or Si-rich phase induces a film type growth. This work demonstrates specific existence of NiSi NW growth [7].

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