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Influence of O contamination and Au cluster properties on the structural features of Si nanowires

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ABSTRACT

Silicon nanowires (Si NWs) are the emerging nanostructures for future nanodevices. In this work we have prepared them by electron beam evaporation (EBE) through the vapor–liquid–solid (VLS) mechanism. We discuss the growth of epitaxial NWs by EBE and the possibility to control their orientation and length by changing the experimental conditions. Moreover, the effects of the surface contamination and of the Au cluster preparation on the NWs structural properties and density will be discussed. We demonstrate that any O contamination has to be avoided since just a very thin native SiO₂ layer stops ad-atom diffusion on the surface and inhibits the NWs growth. Au cluster preparation has a determinant role too: by varying the procedure for their formation, it is possible to change NWs density and length. In particular, we observed that by evaporating Au on the heated substrate, the droplets active to promote NW growth are immediately formed and a faster growth process starts. The growth rate is about a factor of 4 times higher than in the sample where the Au is evaporated at room temperature and the cluster formed after a subsequent thermal annealing. On the contrary, the slower process allows the atom arrangement and ordering in an epitaxial manner, and a precise control of NW orientation can be achieved.

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