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research highlight

Self-assembly: Golden touch

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Controlling the shape, size and composition of nanostructures is essential for devices applications. Now, materials researchers are particularly interested in silicide nanostructures as a means of producing electrical contacts to silicon devices.

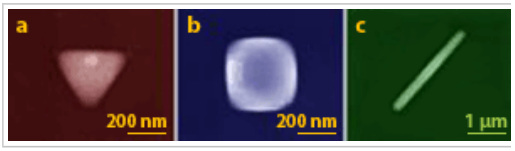

Fig. 1: Scanning electron microscope images of three Cu_3Si nanostructures formed on Si substrates of different orientation.

A team of researchers in Singapore have used gold (Au) nanoparticles to control the shape and size of Cu_3Si—a silicide nanostructure. Interest in this silicide arises from the fact that the Cu/Si interface is important for both electronic and catalytic applications.

Tom Wu, Hongyu Chen and colleagues at the Nanyang Technological University, Singapore, used a vapor transport technique to grow nanoscale silicides. Gold nanoparticles were dispersed on a silicon substrate which was then put into a tube furnace with CuO as the source of Cu. The researchers observed that depending on the substrate orientation used, nanotriangles (NTs), nanosquares (NSs) or nanowires (NWs) were formed (Fig. 1). Notably, the sides of NTs and NS and the axes of the NWs were all oriented along th same direction.

The presence of the Au nanoparticles was essential for the Cu_3Si growth itself, as confirmed by the absenc of nanostructures when Au was not used. The team believes that the SiO_2 surface layer formed when the sample was heated, hindered Si diffusion and subsequent reaction with Cu. However, Au, besides absorbin Cu atoms, enabled the local diffusion of Si through the SiO_2 layer.

Finally, the team confirmed the importance of the Au nanoparticles by showing that the size of Au nanoparticles determined the final dimensions of the Cu_3Si nanoparticles as well.

“This synthesis method sits between the traditional epitaxial thin film growth and the relatively recent vapor-liquid-solid nanomaterials growth, and takes advantages of both approaches,” says Wu. “We expect that appropriate selection of materials combinations will trigger the self-assembled shape- and orientation-controlled growth of other systems beyond silicides. And we are also working on controlling the location of the nanomaterials on the substrates and integrating the nanoscale silicides with silicon-based devices and circuits.”

Reference

1. Zhang, Z., Wong, L.M., Ong, H.G., Wang, Z.J., Wang, J.L., Wang, S.J., Chen, H. & Wu, T. Self-assembled shape- and orientation-controlled synthesis of nanoscale Cu_3Si triangles, squares, and wires. *Nano Lett.* **8**, 3205–3210 (2008) | article |

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