ELECTRICAL TRANSPORT PROPERTIES AND THERMAL INSTABILITY OF GOLD NANOWIRES

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In polycarbonate templates, prepared by heavy-ion irradiation and subsequent chemical etching, Au wires with well-controlled characteristics were electrochemically synthesized [1, 2]. The structural firmness of wires was studied in detail. The Au wires became morphologically fragile due to the Rayleigh instability when annealed at high temperatures. During this process the wires broke up into chains of nanospheres at temperatures far below the bulk melting point [3]. Investigations on the decay of wires of different crystallinity revealed that the single-crystalline $\langle 110 \rangle$ textured wires were more resistant against the Rayleigh decay. This preferential stability can be explained by the presence of highly stable $\{111\}$ facets on the surface of $\langle 110 \rangle$ oriented needles.

The electrical resistance of single gold nanowires embedded in the template has been investigated. The wire resistivity was higher than the bulk value over a wide range of diameters. This is attributed to the additional electron scattering from the wire surface and inner grain boundaries. Measurements of resistivity as a function of temperature demonstrated that in this respect the wires behavior do not differ significantly from bulk metal. The resistivity decreased linearly with temperature up to ~ 50 K and finally approached a residual value.

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