Preferred growth orientation of metallic fcc nanowires under direct and alternating electrodeposition conditions

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Gold and copper nanowires were generated through electrochemical deposition into nanoporous polymeric templates. Depending on the growth conditions, such wires exhibited a distinct textured structure as evidenced by x-ray diffraction. The preferred growth orientation is explained by applying the broken-bond model in combination with surface-energy anisotropy and energy minimization. During the growth process, the aspect ratio of the cylindrical nanowire and thus the area of the mantle surface and its contribution to the total surface energy increase. Under direct current deposition conditions, <110> textured metallic fcc nanowires represent the configuration of lowest surface energy at aspect ratios above 1. Under alternating current deposition conditions, {110} nanowire base surfaces vanish due to their high surface energy, leading to successive development of a <100> texture as the configuration of lowest energy at aspect ratios above 5.