J Material Sci Eng 2018, Volume 7
DOI: 10.4172/2169-0022-C9-117

Growth of nanowires along arbitrary design crystal direction

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The production of nanowire materials, uniformly oriented along any arbitrarily chosen crystal orientation, is an important, yet unsolved, problem in material science. Weto devised a generalizable solution to this material science problem, using FeCo as the demonstration material system. The solution is based on the technique of glancing angle deposition combined with a rapid switching of the deposition direction between crystal symmetry positions. We showcase the power and simplicity of the process in one-step fabrications of <1 0 0>, <1 1 0>, <1 1 1>, <2 1 0>, <3 1 0>, <3 2 0> and <3 2 1>-oriented nanowires, three-dimensional nanowire spirals, core-shell heterostructures and axial hybrids. The resulting nanowires are single-crystals, have high saturation magnetization of 2.0(2) Tesla, and passivated by a surface oxide below 3 nm in thickness after one year of storage in air. Our results provide a new capability for tailoring the shape and properties of nanowires, should be generalizable to any material that can be grown as a single-crystal biaxial film, and has already offered a new route towards next-generation tip-on-cantilever magnetomechanical sensors for atomic resolution magnetic resonance imaging.

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