

Supporting Information

Growth and characterization of metastable hexagonal nickel thin films via plasma-enhanced atomic layer deposition

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Abstract

There is a great interest in various branches of the advanced materials industry for the development of novel methods (and improvements to existing ones) for the deposition of conformal ultrathin metallic films. In most of these applications, like enhanced solar absorbers and microelectronics, achieving the capacity to deposit a conformal thin film on a three-dimensional structure is an important condition. Plasma-enhanced atomic layer deposition (ALD) is known for its potential for growth of conformal thin films with a precise control over the thickness, and its capability for deposition at relatively low temperatures (below 500°C). This study evaluates the potential of plasma-enhanced ALD for growth of conformal nickel thin films, using bis(ethylcyclopentadienyl)nickel and nitrogen/hydrogen plasma as precursors. A comprehensive analysis of the structure, composition, and physical properties of the films was performed. The results indicate that conformal nickel films with low levels of impurity were successfully deposited on sapphire. The films had a roughness of $R_a=1.5$ nm and were seen to be under strain. The deposited nickel had a hexagonal crystal structure, with a random in-plane orientation of the grains, while the grains had their c-axes oriented along the normal to the interface. These results pave the way for conformal low-temperature deposition of high quality nickel thin films on three-dimensional structures.

Keywords: Nickel; ALD; Atomic layer deposition; hexagonal; HCP; XRD; TEM; AFM

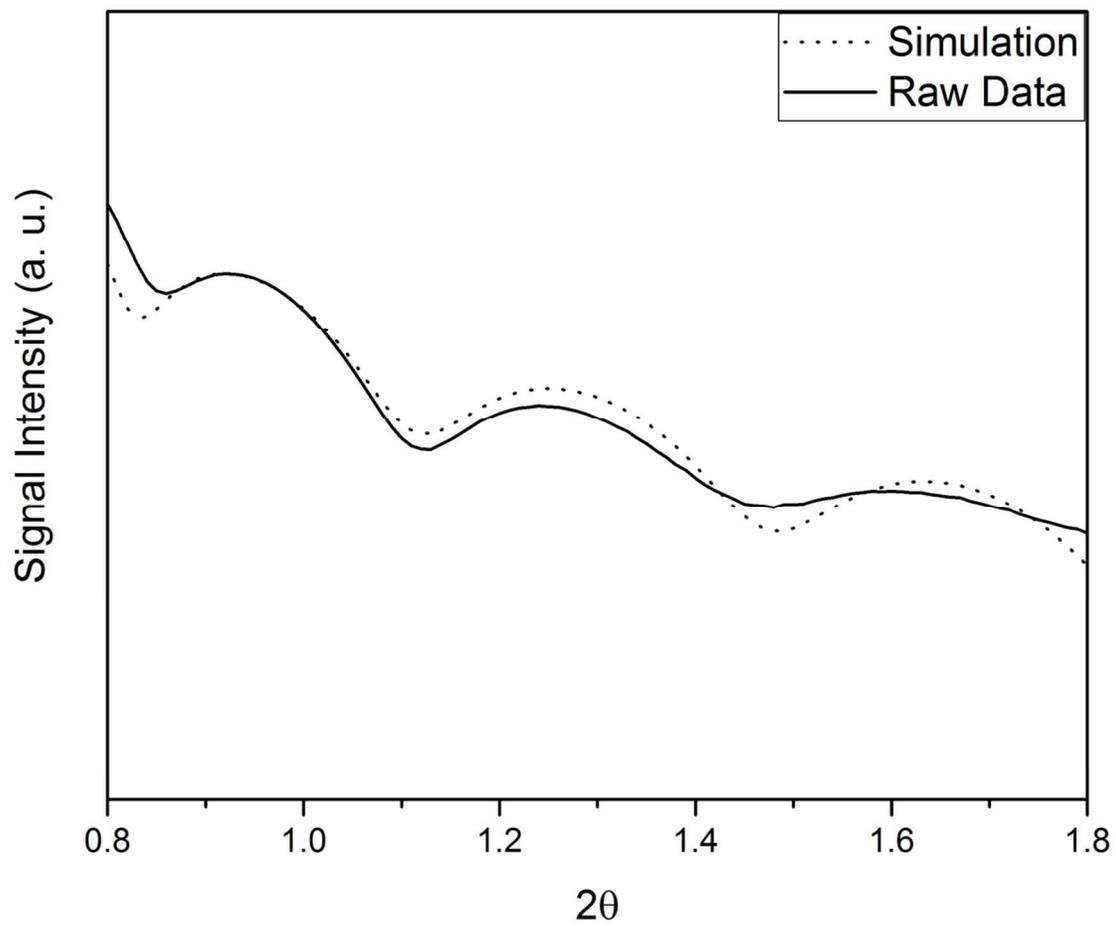


Figure S1: The experimental and software-generated XRR curves featuring Kiessig fringes of the sample Ni-400.

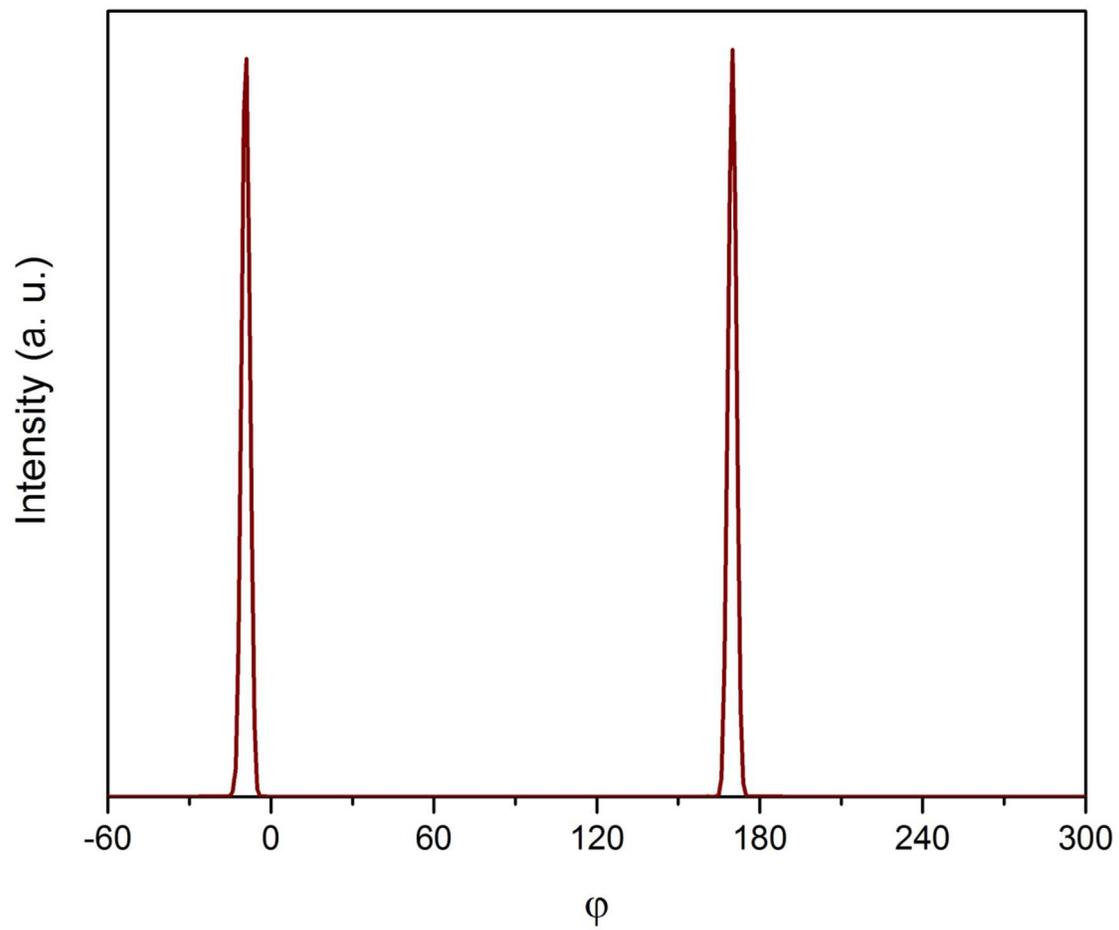


Figure S2: An azimuthal scan (φ scan), resulting from 360° in-plane rotation of the sample at $\omega=20.8^\circ$ and $2\theta=41.6^\circ$.