TEMPERATURE DEPENDENT MAGNETIC PROPERTIES OF Ni NANOTUBES SYNTHESIZED BY ATOMIC LAYER DEPOSITION

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On one hand, template-based electrodeposition of magnetic nanotubes is a straightforward route with reasonably well controlled dimensions, morphology and chemical composition. It is the most practiced method for fabrication of Ni nanotubes. However, it is difficult to synthesize ultrathin, homogeneous and smooth Ni tubes with a wall thickness of several nanometers using this technique. On the other hand, atomic layer deposition (ALD) technique, featured with self-limiting surface reactions, is ideal for the synthesis of Ni nanotubes due to its precise control of the thickness at the monolayer level, excellent step coverage and conformal deposition on high aspect ratio structures. Contrary to the classical chemical vapor deposition, ALD allows for conformal deposition by using sequential gas-solid surface reactions of two species (X, Y). An ALD cycle consists of two consecutive self-limiting (half-) reactions of X and Y with active surface sites. Since the chemical deposition reaction is not limited by the absolute mass transport of precursor molecules, homogeneous coatings with sub-nm thickness control can be achieved by accurately adjusting the number of ALD cycles.

Understanding the magnetic properties of Ni nanotubes has become increasingly important since they were suggested for potential applications in spintronics, data storages and bio-applications. However, temperature dependent magnetic properties of these nanotubes have limited reports due to difficult control over morphology and internal structure of the nanotubes. Thus, in this poster we present highly ordered and conformal Ni nanotube arrays by combining ALD with a subsequent thermal reduction process. In order to obtain NiO tubes, one ALD NiCp$_2$/O$_3$ cycle was repeated 2000 times. After the ALD process, the sample is reduced from NiO to metallic Ni under hydrogen atmosphere. Their magnetic properties such as coercivity and squareness have been determined in a vibrating sample magnetometer in the temperature range from 5 to 300 K for applied magnetic fields parallel to the nanotube axis. Ni nanotubes synthesized by ALD provides a promising opportunity for potential applications in spintronics, data storages and bio-applications.

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