Simultaneous synthesis of cobalt nanoparticles and carbon nanotubes directly on conductive substrates are of special interest since it allows the fabrication of quasi one-dimensional hybrid systems with tunable properties and a wide range of applications in nano and microelectronics, spintronic and magnetic information storage. Since metals are high-surface energy materials, it is difficult to stabilize metal nanoparticles for nanotube growth directly on metal surfaces. In this work we present a simple and reliable fabrication approach to produce controlled Co magnetic nanoparticles by solid state dewetting of metal films deposited on a conductive substrates acting as barriers. Indeed, refractory conductive films such as titanium silicon nitride TiSiN were proposed as barriers to limit catalyst diffusion into the bulk of the substrate. In addition, the low surface energy of TiSiN favors catalyst de-wetting, thereby improving nanotube forest density and verticality. Titanium silicon nitride films were first deposited on silicon wafers by thermionic vacuum arc. Then, ultra-thin cobalt films with thickness up to 3 nm were deposited on the top of TiSiN; the dewetting process of the cobalt films was achieved by thermal heating followed by plasma treatment. After these steps, the initial continuous layer breaks up into isolated nanoparticles. Finally, carbon nanotube grow by methane decomposition on the cobalt nanoparticles by using plasma enhanced chemical vapor deposition (PECVD) reactor. In particular, the microscopic analysis showed that the density and the size of the generated nanoparticles depend on the thickness of the deposited cobalt films as well as the control of thermally activated processes mainly bulk diffusion. On the other hand, the magnetic properties measurements confirmed that the design of nanoparticles and their size distribution control their coercive field. In this direction, high-ordered self-organized cobalt/nanotube hybrid systems could be proposed as functional nanostructured elements in magnetic information storage devices.

Recent Publications

Biography
A Andalouci studied Petrochemical Engineering at the Faculty of the Chemistry and Hydrocarbons, Algeria, in 2015, and he also obtained his Master degree in Physics of Material from University of Paris 13, France, in 2017. He is currently a PhD student in the PPANAM axe at the LSPM laboratory of the University Paris 13. His research interests include the synthesis and functionalization of carbon nanotubes and nanomaterials for microelectronic and magnetic applications.

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