Templates for engineered nano-objects for use in microwave, electronic devices and biomedical sensing applications

Rendicontazione

Informazioni relative al progetto

NANOTEMPLATES

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Progetto chiuso

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Final Report Summary - NANOTEMPLATES (Templates for engineered nano-objects for use in microwave, electronic devices and biomedical sensing applications)

The ultimate aim of the NANOTEMPLATES project was to extend the frontiers of science in the area of nanotemplates with the aim of synthesising nano-object, presenting advantageous properties-discontinuities arising from the nanoregime.

Nanoporous templates were developed and fabricated employing the technology based on heavy ion bombardment and track etching of polymer films or polymer layers deposited on varied substrates such as wafer, glass and metal. Track etching process was extended to new types of templates and further fundamentally investigated by in-situ Fourier transform infrared (FTIR) spectroscopy of heavy ion irradiated polycarbonate film and model compounds. Templated growth within track etched material was, therefore, efficient for the production of arrays of controlled metallic-single cobalt (Co), nickel (Ni), gold (Au), alloys (CoFe, NiFe), multi-layered (Co/Cu) or polymeric-light emitting polymers-nanoobjects.

An alternative and unique tool based on the adaptation of an Atomic force microscopy (AFM) was developed to elaborate nanotemplates with pores of ultra-small dimensions down to a few nanometres. The AFM indentation technique was validated to obtain 1 MOhm nanocontacts with dimensions smaller than 1 nm. These AFM nanotemplates were versatile and could be used for making nanojunctions or to connect a single nanoobject, thus enabling the probe into the physics of spin polarised transport in ultra-small objects.

Nanoobjects elaborated in this project were characterised with regard to their specific optical, magnetic and chemical properties.

Giant magnetoresistance (GMR) and Tunelling magnetoresistance (TMR) were investigated to explore the limits of magnetoresistive effects and potential application in a sensor for automotive contact-less positioning system.

Microwave properties of ferromagnetic nanowire arrays embedded into a polymer template were extensively considered and the possibility of making circulators operating at various frequencies without any external magnetic bias was demonstrated. The main performance limitation factors were clearly identified and, based on the modelling and measurements, new circulator designs are, therefore, proposed to reach competitive devices.

The use of nanotemplates was also considered as a way to confine the optical field into a micropillar cavity and, therefore, to increase the spontaneous emission rate of a light-emitting polymer. Two device structures were investigated.

Pure magnetic Ni, pure Au and bilayered Ni/Au nanowires were grown within nanotemplates in order to be recovered for bio-applications using microfluid devices. Magnetic Ni section made the wires susceptible to an outer magnetic field, namely their position could be controlled while the Au section could be modified with DNA. However, nanowires aggregated once they were released from the substrate and could not be useful in a clinical assay.

Nevertheless, a suite of microfluidic devices which could use such nanoparticles were developed for

mRNA purification and reverse transcription of mRNA to cDNA. Their use which followed a current protocol for the detection of chronic myeloid leukaemia was promising, as it cut the assay time to one third.

Documenti correlati

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