Magnetic Interfaces and Nanostructures
Room 3rd Floor Lobby - Session MI-TuP

Magnetic Interfaces and Nanostructures Poster Session

MI-TuP1 Facile Fabrication of High Resolution Magnetic Force Microscopy Probes via Localized Electrochemical Reduction of Cobalt Species*, M. Rolandi,* University of California, Lawrence Berkeley National Laboratory*; S.A. Backer, D. Okawa,* University of California, Berkeley*; J.M.J. Fréchet,* University of California, Lawrence Berkeley National Laboratory

Magnetic force microscopy (MFM) is a scanning probe technique capable of characterizing the ever smaller nanostructures developed for the next generation data storage. Advancements in imaging resolution require new approaches in probe design and fabrication, an ideal probe consists of an ultra-sharp tip with magnetic material confined only at the apex. We propose a novel technique for fabricating high resolution MFM probes based on the localized electrochemical reduction of Cobalt (II) species in solution. Specific Co deposition at the apex of the tip is obtained by localizing the reaction in the small gap between the negatively biased probe and the sample while the probe is immersed in an AFM fluid cell. We demonstrate that specific deposition also occurs in a macroscopic electrochemical cell geometry when a high frequency alternating potential is applied. Once fabricated, the functional probes are characterized using scanning electron microscopy and energy dispersion elemental analysis. MFM is performed on the track of a longitudinal recording medium and features as small as 50 nm are clearly resolved. Power spectral density analysis of the images suggests a resolution as high as 25 nm can be achieved. In conclusion, we have developed a facile method for MFM tip fabrication easily scalable for parallel production.

MI-TuP2 RF Atmospheric Plasma Systems for Nanopowder Production and Deposition of Nanocrystallines*, Y. Glukhoy,* American Advanced Ion Beam, Inc.*; I. Ivanov,* 4 Star, Inc.

Two types of RF atmospheric plasma systems were developed for production of magnetic nanopowder. DC-RF-RF system is supplied by a retrofitted DC plasmatron to convert precursor in powder or aqueous substance into the flow of melted droplets. The DC torch provides a high temperature in the small area in vicinity of the cathode where precursor with a high enthalpy is injected in the discharge through the axial hole. This torch triggers also following atmospheric inductively coupled plasma (ICP) discharge up to self sustaining. So total evaporation and gas-vapor plasma chemical reaction in the fly were implemented in the large high temperature area of the RF reactor where two RF coils at frequencies 13.56 MHz and 27.12 MHz with total RF power up to 18 kW sustain the ICP discharge in the water-cooled 12" long quartz tube with 4.5" OD. The melted droplets were pinched in an axial vapor flow mixed with the process gases. The Laval nozzle at the end of the reactor provides quenching of such a gas-vapor flow and nucleation of mixture in the fly. It simultaneously protects the oil mist that captures the nanoparticles in nanopowder production mode or the polymer substrate in the nanocoating one from the heat flux irradiated by plasma. But production of the ultra-high purity magnetic nanopowder, particularly for drag delivery in the cancer therapy requests the ultra clean technology. We have built a second device where a commercial ICP plasma torch as a melted droplet generator and trigger of the RF reactor was used. The length of the following RF reactor was reduced twice due to the relatively low velocity of the flow. Therefore, just one saddle-like RF antenna that concentrates all RF power inside the inner volume was used in the second stage. Estimation of the atmospheric plasma parameters and of the cooling time in the Laval nozzle is presented. @FootnoteText@Y.Glukhoy, el: Method and apparatus for manufacturing of nanoparticles. US Patent Appl. 20050258149 Nov 24, 2005.

MI-TuP4 Properties of LT-MBE Ga@sub 1-x@Mn@sub x@As Regrown on InGaP/GaAs Prepared Substrates*, J.S. Lee, H.K. Choi, W.O. Lee, Y.D. Park,* Seoul National University, Korea

We report on the structural, magnetic, and transport properties of LT-MBE Ga@sub 1-x@Mn@sub x@As regrowth on MOCVD prepared GaAs(500 nm)/In@sub 1-y@Ga@sub y@P(500 nm)/GaAs(001) and In@sub 1-y@Ga@sub y@P(500 nm)/GaAs(001) substrates. In-situ RHEED indicate a layer-by-layer growth with typical 2 x 4 pattern during regrowth of a GaAs buffer layer preceding 1 x 2 pattern during 100 nm of Ga@sub 1-x@Mn@sub x@As. @theta@-2@theta@ HRXRD measurements show characteristic features for only the Ga@sub 1-x@Mn@sub x@As epilayers and In@sub 1-y@Ga@sub y@P/GaAs(001) substrate. SQUID magnetization measurements indicate magnetic ordering temperatures (T@sub C@'s) of regrown Ga@sub 1-x@Mn@sub x@As to be similar to Ga@sub 1-x@Mn@sub x@As/GaAs(001), with indications of an increase in in-plane uniaxial anisotropy field terms from BH loops measurements at 5 K with H || to (110) and (1-10). Similar to Ga@sub 1-x@Mn@sub x@As/GaAs(001), annealing at low temperatures (250°C for 1 hour) increases T@sub C@. Transport measurements show insulator-like behavior for as-grown samples with Mn content. For similar Mn content, Ga@sub 1-x@Mn@sub x@As/GaAs(001) show metallic-like behavior. We will also discuss realization of Ga@sub 1-x@Mn@sub x@As suspended NEMS and MEMS structures suitable for further investigations on the origins of magnetic ordering in Ga@sub 1-x@Mn@sub x@As diluted magnetic semiconductors.

MI-TuP8 Low Noise, High Sensitivity Anisotropic Magnetoresistive Sensors with Second Harmonic Readout*, S.T. Halloran, H. Fardi, F.C.S. da Silva,* University of Colorado*; D.P. Pappas, R.R. Owings,* National Institute of Standards and Technology*; E.W. Hill,* University of Manchester

Low noise magnetic field sensors have a wide range of applications. At present, the best signal-to-noise ratio (SNR) sensors on the market are based on anisotropic magneto-resistance (AMR). In this work we demonstrate low noise sensors that operate by modulating the bias on soft-adjacent-layer (SAL)-biased AMR devices and sensing the second harmonic signal. The 2f technique allows us to move the signal above the 1/f noise regime and into a less noisy bandwidth. We have measured the noise response of these sensors and demonstrated the scalability of the noise with the volume of the sensor. Using the Johnson noise limit, we show that a sensitivity of 1 pT/@sr@Hz is achievable in these devices at reasonable power levels. In addition, we show that the 2f detection is capable of providing high-contrast magnetic field images that reject thermal asperities. This is due to the fact that the interaction of the bias current and magnetic moment of the sensor is independent of the sign of the bias current. Sensors are fabricated by DC sputtering (80)Ni(20)Fe onto a Ta seed layer in a needle pattern. The SAL bias is achieved with NiFe as well, separated from the MR layer by a thin SiN insulating layer. The needle is 20 µm wide by 200 µm long with an overall thickness of 0.450 µm. The needle aspect ratio of 4:1 (or a needle angle of 30 degrees) is chosen to optimize the single-domain formation by preventing vortices from forming. The magneto-resistor (MR) layer was sputtered in a 200 Oe field along the easy axis of the sensor. Full bias is provided by the SAL. Initial findings show a preferred bias at 15 mA which corresponds to a RMS voltage (peak to peak) of 5.2 at 1 KHz. We used a lock-in technique to generate the 2f signal from the differential output of the bridge. A custom MR looper was built to characterize these sensors. Applications include arrays of bridges for high-resolution scanned MR microscopy including room temperature magnetocardiograms.

Author Index

Bold page numbers indicate presenter