Influence of magnetic field on the tunneling current in magnetic 10-nm-scale point contact junctions using tunneling atomic force microscopy

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Spin-dependent magnetic tunneling junctions (MTJs) with 'half-metal' have high potential for attaining large magnetoresistance. The ideal half-metal, such as magnetite (Fe_3O_4), possesses high spin polarization (up to 100%), while the quality of fabricated films strongly affects the distribution of local spin polarization. Usually, a substrate temperature as high as 300 °C is required for depositing stoichiometric Fe_3O_4 thin films. However, we could successfully fabricated them at room temperature in this study, using Kr ion bombardment at the energy of 160 eV during the deposition. We also fabricated point-contact MTJs smaller than 100 nm by using a tunneling atomic force microscope (AFM) to reduce the device size for future ultra-high density recording. Our junctions are formed from an AFM cantilever coated with a soft magnetic material contacting [Al-O (1nm)/Fe_3O_4 (50nm)/Ru (5nm)] films. The effect of applied magnetic field on the tunneling current distribution through an Al-O barrier is investigated using a tunneling AFM. With decrease of the field from 100 Oe to 0, the threshold voltage for detection of tunneling current is dramatically reduced from -4.4 V to -1.5 V, impinging on the resistivity. The magnetization of the magnetically soft coating on the AFM cantilever is easily aligned along the applied field direction, while that of Fe_3O_4 retains its original direction. These facts suggest that the tunneling magnetoresistive effect occurs even for a point contact size as small as a few tens of nanometers.

Organic Thin-Film Transistors Based on Anthracene Oligomers

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Thin-film transistors with an organic active layer (OTFTs) have attracted a great deal of interest for use in lightweight, low-cost, large-area and flexible electronics such as flat-panel displays, sensors, smart cards and radio-frequency identification (RFID) tags. We have fabricated and characterized thin films of organic semiconducting anthracene oligomers; 2,2'-bianthracene (2A), 2,6-trianthracene (3A), and their dihexyl derivatives (DH-2A and DH-3A). It was found that the films had a high degree of lamellar ordering and crystallinity. The lamellar structure grew parallel to the substrate, which formed large monomolecular terraces at high substrate temperatures. These film structures can provide good carrier transport since the direction of π-orbital overlapping is parallel to the substrate surface. OTFTs based on the anthracene oligomers were fabricated and were found to exhibit p-type and enhancement-mode characteristics. The field-effect mobility of the OTFTs was increased by the oligomerization and the substitution of alkyl groups. Accordingly, the highest mobility was shown by DH-2A OTFTs (0.13 cm^2/Vs). The mobility can be improved by using a silane coupling agent. In addition, OTFTs with an anodized Ta_2O_5 gate insulator were fabricated and were experimentally shown to have improved electrical characteristics. It can thus be concluded from this study that thin-film transistor based on anthracene and higher acene oligomers will be essential components in future electronic devices.

Geometrical effects of positional errors in integral photography

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Integral photography (IP) is a method that reconstructs the light beams from objects.

If the lens arrays of the capturing system and display system are not aligned accurately, positional errors of elements (elemental lenses and elemental images) may occur, causing the three-dimensional (3-D) image to be reconstructed in an incorrect position. We have clarified the geometrical effects of positional errors in IP. In the discussion, the positional errors have been examined by dividing them into two types, namely local errors and global errors. The following conclusions were derived. A 3-D image is separated when the 3-D imaging system based on IP has a local error. On the other hand, when the system has a global error, the 3-D image does not converge to a single point, causing blurring. In both cases, 3-D images reconstructed far from the lens array are greatly affected and the viewing area is narrowed by these positional errors.

Moreover, unlike the case of a local error, a reconstructed image is shifted in the depth direction by the global error. These results will be important for realizing IP with high resolution and large area.