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13. ABSTRACT *(Maximum 200 words)*

Under the AASERT program, our student developed magnetically active II-VI diluted magnetic semiconductor (DMS) surface quantum well "substrates" upon which to epitaxially grow and pattern ferromagnetic Fe films in order to produce spin-dependent potentials. This material phase produced a variety of flux-focusing magnetic patterns including planar wedges and variable-spaced single domain particle arrays with nominally 0.1-0.5 micron feature sizes. These patterns are designed to create a field-driven spin-dependent energy landscape for optically-pumped or doped carriers and provide a basis for spatial measurements of electronic spin transport.

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Femtosecond Near-field Spin Microscopy of Magnetic/Superconducting Heterostructures

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In contrast to embedding magnetic moments within a semiconductor heterostructure, it is important to demonstrate an ability to guide spin-dependent transport using field gradients from magnetic films grown upon a semiconductor heterostructure. The spin-dependent properties of these magnetically-patterned nanostructures is presently being resolved using both near-field scanning optical microscopy (NSOM) and magnetotransport studies. Under the AASERT program, our student developed magnetically active II-VI diluted magnetic semiconductor (DMS) surface quantum well "substrates" upon which to epitaxially grow and pattern ferromagnetic Fe films in order to produce spin-dependent potentials. This material phase produced a variety of flux-focusing magnetic patterns including planar wedges and variable-spaced single domain particle arrays with nominally 0.1-0.5 micron feature sizes. These patterns are designed to create a field-driven spin-dependent energy landscape for optically-pumped or doped carriers and provide a basis for spatial measurements of electronic spin transport. Both insulating and conducting substrates have been prepared for the optical and transport measurements.

We have grown hybrid ferromagnetic-DMS quantum well structures by depositing typically 50 nm thick epitaxial films of Fe on top of a single ~ 12 nm quantum well containing 3 monolayers of Mn ions. Figure 1 shows an example of a recent result in collaboration with Dr. Gary Prinz of the Naval Research Laboratory. This wet-etched single-crystal Fe film was processed using a newly developed chemical technique, *without any electronic degradation of the underlying semiconductor heterostructure.*

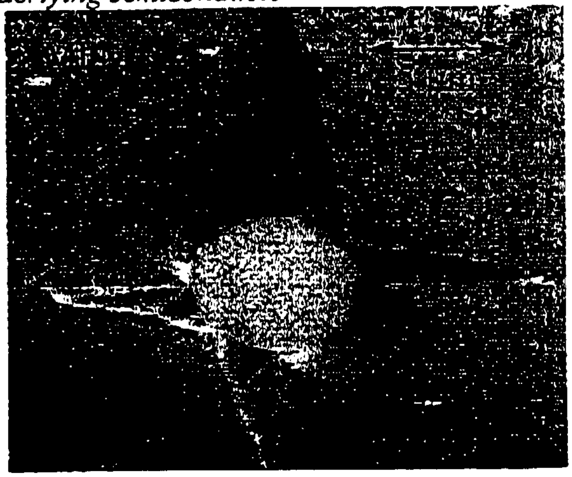

Fig. 1. Magnetic force microscopy image of a 5 micron hole etched through a 50 nm-thick crystalline Fe film grown upon a 12 nm ZnSe/ZnCdSe quantum well containing 12-1/4 monolayer MnSe planes (a digital magnetic heterostructure). At B=0, star-shaped domain walls form to minimize the free-energy of the in-plane field, creating large field gradients at the edges of the hole. For B>3 G, the domain walls sweep away leaving very large gradients around