

Nanoelectronics Undergraduate Research Fellowship (NURF) 2010 Project Summary

Student name: Patrick Newcomer
Faculty mentor name: Tao Wang
Project title: Electromagnetic Tweezers Array

Magnetic tweezers are electromagnetic structures that are able to manipulate paramagnetic particles in different magnetic field gradients. However, magnetic tweezers designs are held limited by the single-tweezers design, tweezers that can only push the magnets in one direction, and macro scale fabrication process, hand-wind coils and machined magnets.

The purpose for the summer research was to design unique arrays for the layout of the ferromagnetic cores, drive circuits and bonding pads, with varying sizes of the ferromagnetic cores from 4 μm up to 20 μm . The microelectromechanical systems fabrications techniques used were mask design software, lithography and thin film deposition using a physical vapor deposition. Two unique array designs were created and can be seen in the image below. The construction of the design onto the silicon wafer did not yield the expected results. The main cause of this was due to the use of the thick photoresist of AZ 4620, $\sim 4 \mu\text{m}$. In future fabrication of the design a thinner photoresist like SU-8, or similarly thin photoresist, in the $\sim 1 \mu\text{m}$ range should range a better transfer of the mask design to the wafer.

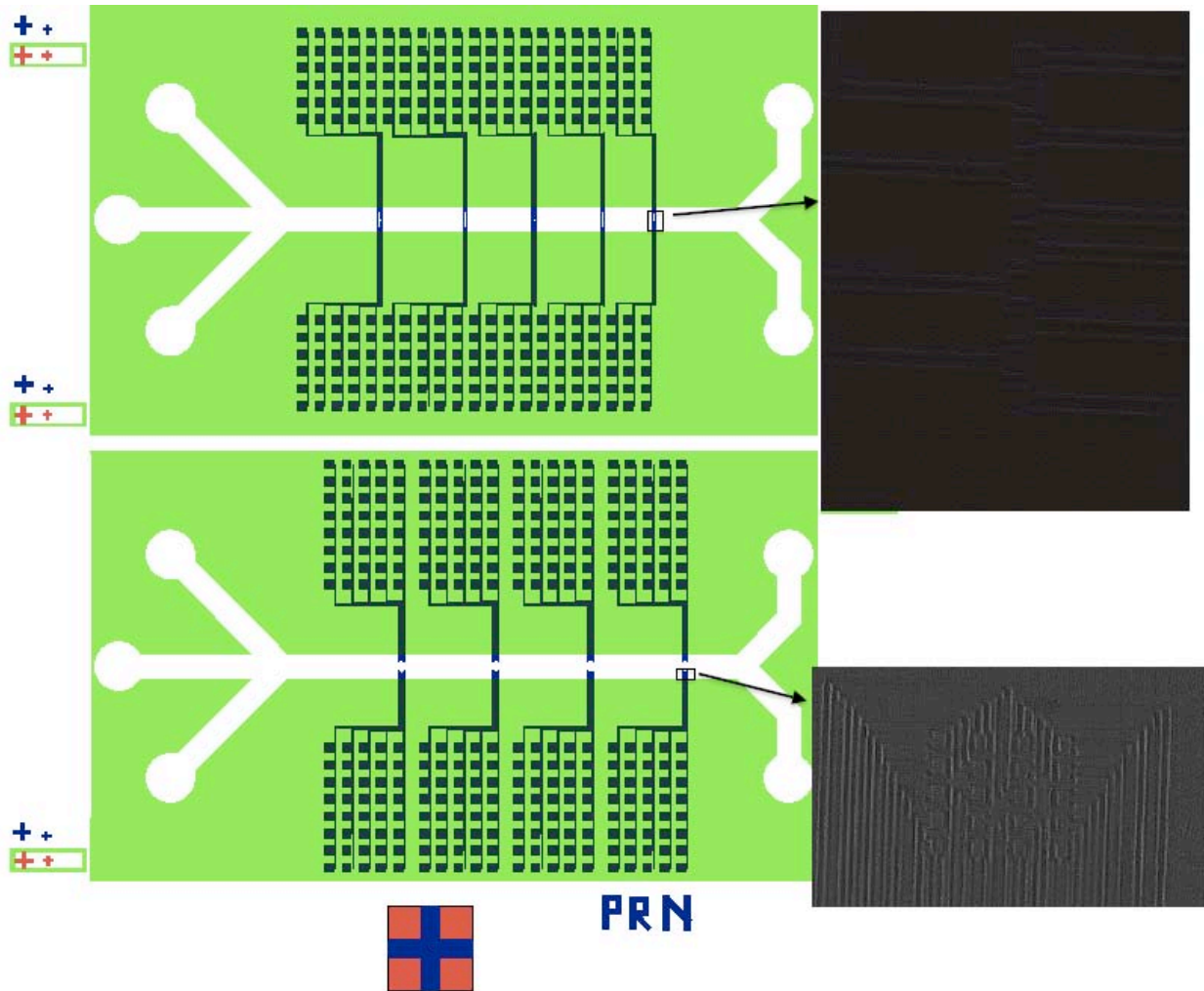


Figure 1: L-Edit software design for the emulsion plates. The three layers are color coated, green for the negative image of the microfluidic channel, blue for the drive circuits, and red for ferromagnetic cores. The images on the right are of the two designed arrays for the 4μm cores at 100x magnification.

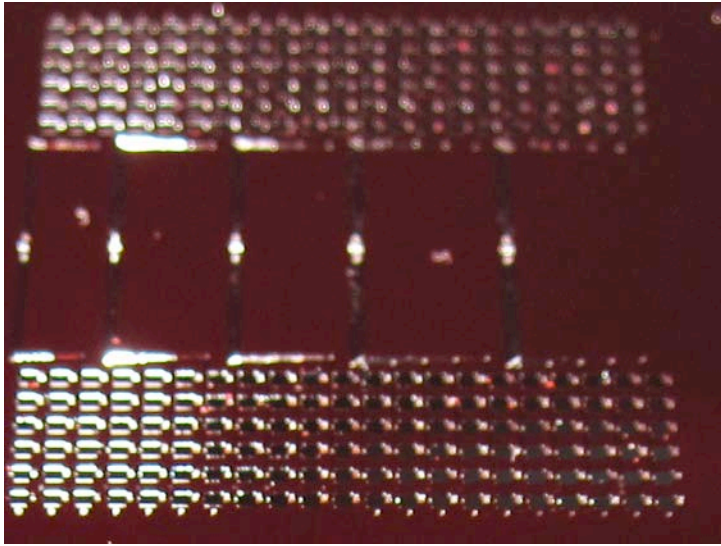


Figure 2: Image of the silicon wafer with the design in the AZ 4620 PR.