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Fabrication of Micro-Electromagnetic Devices for the Manipulation of Carbon Nanotubes JOHN BRIDSTRUP, ANTHONY SPEZIALE, SCOTT PAULSON, James Madison University — With advances in microscopy techniques, such as transmission electron and scanning transmission electron microscopy, it has become increasingly more interesting to study and manipulate the structures of solid state materials at the atomic scale. One of the issues with the study of these properties is that these advanced microscopes require that the sample be confined to a space not very conducive to traditional methods of actuation, such as atomic force microscopy and electrostatic methods. In our research, we are primarily focused on building tiny "electro-magneto-mechanical" devices on carbon nanotubes in order to manipulate them without breaking vacuum or removing them from the microscope. Our current project is focused on putting small, magnetizable paddles on to the carbon nanotubes, using an SEM for electron beam lithography and a metal evaporation deposition system, then running current to induce a magnetic field with which the paddles, which can have any magnetic dipole we want, will align. In order to create these devices we must first choose a type of material and a method for creating the magnetic paddles, in our work we use iron. The main problem with iron is the rate at which it oxidizes at the nanoscale, it is practically instantaneous. Because of this we have developed a method, using what basically amounts to simple geometry, for encasing our iron paddles with gold and thus preventing the oxidation. It is our hope that this research opens the doors for many new opportunities in nanoscale materials science, and at the least greatly reduce the time required for many current experiments.

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