Electrodeposition, like biomineralization, is a soft solution processing method in which inorganic materials are produced from solution precursors. The technique provides degrees of freedom that are not accessible to UHV deposition methods. The shape, orientation, and even chirality can be controlled through solution additives, pH, and electrode potential. Our emphasis is on producing epitaxial nanostructures of metal oxide semiconductors such as ZnO and Cu2O, magnetic materials such as Fe3O4, and battery materials such as LiMnO2. These materials are being produced for both the conversion and storage of energy. Cu2O is produced for photovoltaic devices and ZnO is produced for both photovoltaic devices and solid state lighting. Because the ZnO deposits as nanowires, electron-hole recombination can be minimized. We have recently found that ZnO can be epitaxially grown on single-crystal Si(111). In addition to exciton PL emission from the ZnO, there is also strong green emission due to native defects. Fe3O4 is being produced as thin films and superlattices for spintronic devices. Nanoribbons of LiMnO2 are deposited for use in high capacity lithium batteries. This material is presently used in Li batteries, but it is made by traditional powder metallurgy methods. The electrodeposition of nanostructured cathodes of this material could prove to be a major breakthrough in the lithium battery field.