NSF Award in Mathematical and Physical Sciences: Materials Research

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- **Title:** Acquisition of a SAXS/MAXS/WAXS Detector System for Nanoscale Studies of Soft Materials
- **Start Date:** February 1, 2010
- **Total Award Amount:** $755,415

**How the results of this project will benefit society:**
National user facilities form a vital infrastructure supporting American competitiveness in science, engineering and technology. By providing researchers access to cutting edge experimental capabilities, such facilities also contribute materially to the education and training of a sophisticated scientific workforce. The premier facility for x-ray science in the western hemisphere is the Advanced Photon Source (APS), located at Argonne National Laboratory. The APS generates extremely intense x-ray beams that may be used in many ways to study fundamental problems in biology, chemistry, physics, materials, and technology.

In this project, MRI-R2 funds will be used for the acquisition and commissioning of a new detector system to be installed at the Advanced Photon Source to greatly enhance capabilities for x-ray scattering research. Through its installation at the Advance Photon Source, these new capabilities will be made available scientists from all over the US, and used for studies of fundamental problems in biology, nanoscience and chemistry, as well as in technologically-oriented work in the characterization and processing of polymers catalysts, and other engineering materials.

**The problem the project is trying to solve:**
One class of techniques, known as x-ray scattering, involves measuring the way in which a beam of x-rays is deflected or scattered by a sample’s microscopic internal structure. Analysis of scattering images provides deep insights into a sample’s structure over length scales from ~ 0.1 nm (the size of atoms) to ~ 100 nm (the size of very large molecules such as proteins).

**How this project will work:**
Detectors are the “cameras” that collect scattering images, and hence are at the heart of x-ray scattering techniques. The unique system being developed in this project will combine three separate detectors that will enable simultaneous investigation of samples’ structure over the entire range of length scales studied using x-ray scattering (by analogy, imagine a camera that can simultaneously take a high quality picture of both a dog and a flea sitting on the dog’s back). The detectors will also operate at much higher speed than currently available systems, allowing real time studies of molecular and nano-scale structural dynamics.

This award is funded under the American Recovery and Reinvestment Act of 2009, NSF Award number: 0960140.