distance, to determine the average number of nanoparticles associated with each microsphere, and to define the correlations among the nanoparticles in the halos. Our observations, based on ultra-small-angle X-ray scattering, reveal the fundamental nature and structure of the haloing effect, and demonstrate that the nanoparticles are separated from the microsphere by a distance close to the Debye screening length of the solution.

Keywords: colloidal suspensions, photonic crystals, small-angle x-ray scattering

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Self-assembled magnetite particles formed 4.6 billion years ago

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We report magnetite colloidal crystals formed in the space 4.6 billion years ago. In the meteorite parent body there were abundant waters, and some minerals were generated as a result of the aqueous alteration. Magnetite (Fe_3O_4) is one of typical minerals formed by the aqueous alteration. We found the colloidal crystals composed of magnetite with various morphologies, e.g. octahedral and rhombic dodecahedral. These morphologies determine the structure of the colloidal crystals: in the case of octahedral morphology, the lattice structure is body centered cubic (BCC), while the lattice structure is face centered cubic (FCC) in the case of rhombic dodecahedral morphology. This relationship was not observed for spherical constituent particles. It is known that a repulsive force between particles is necessary for the formation of colloidal crystals. Magnetite has a magnetic force that results in strong attraction between the particles. It suggests that other particles that have no or weak magnetic force must be the precursor for magnetite colloidal crystal formation. These precursor particles could disperse in solution and subsequently form of the colloidal crystals, finally transformed into magnetite. A possible candidate is greigite, which was observed at the surface of the magnetite particles.

Keywords: colloids, magnetic particles, meteorite

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Total scattering: The key to the local and medium range structure of complex materials

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Structural characterization is mainly based on the measurement of Bragg intensities and yields the average structure of the crystalline material. However, this approach ignores any defects or local structural deviations that manifest themselves as diffuse scattering. It also fails in case of disordered materials, badly crystalline such as many nano-materials, or not crystalline at all, such as glasses. In some cases crystalline and amorphous phases coexist making the traditional crystallographic structure refinement difficult or incomplete. The total scattering pattern, however, contains structural information over all length scales and can be used to obtain a complete structural picture of complex materials. Suddenly one has access to a new parameter, the real-space range of the refinement and structures can be analyzed as function of length scale straight forwardly. Here we present different applications of this technique including data taken on the high resolution neutron powder diffractometer NPDF located at the Lujan Neutron Scattering Center at Los Alamos National Laboratory. This instrument is design for total scattering studies using the Pair Distribution Function (PDF) approach and length scales in excess of 200A can be accessed.

Keywords: total scattering, disordered materials, neutron powder diffraction

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New opportunity to explore noncrystalline materials by neutron total diffractometer (NOVA) at J-PARC

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A neutron total diffractometer, named “NOVA”, is constructing now at Japan Proton Accelerator Research Complex (J-PARC). NOVA will be used as very intense powder diffractometer since