SSG

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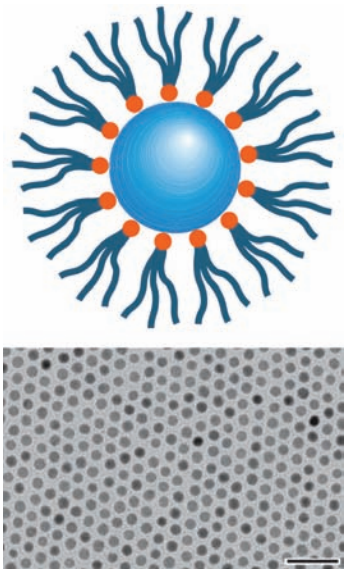

Top: Illustration of a colloidal nanocrystal with a cobalt center surrounded by a ligand layer made up of molecules of an organic surfactant (oleic acid). Bottom: Transmission electron microscope (TEM) image of cobalt nanocrystals. Scale bar = 50 nm.

metal sulfide nanoparticles [Moreau et al., *Science* **316,** 1600 (2007)]. They found that proteins trapped within the nanoparticles may have played a key role in the aggregation process. Sulfate-reducing bacteria can lower the concentrations of metals in anoxic waters by sequestering metals into nanoparticles. The worry is that these very small particles could be highly mobile, redissolving quickly if conditions change. The results presented in the paper, however, suggest that microbially derived extracellular proteins can limit dispersal of nanoparticulate metal-bearing phases, such as the mineral products of bioremediation that may otherwise be transported away from their source by subsurface fluid flow. This work used the high spatial resolution of Beamline 1.4.3 to spectrally identify the presence of proteins within these nanoparticles.

Colloidal nanocrystals (crystalline nanoclusters suspended in liquid) were analyzed using a combination of x-ray absorption and emission spectroscopies at Beamline 7.0.1 [Liu, et al., *Nano Letters* **7,** 1919 (2007)]. Because these techniques normally are conducted on solids in ultrahigh vacuum, application to nanocrystals in liquid required development of a new water cell with sufficiently thin windows to allow the x rays to be absorbed and emitted to the detector. Special care was taken to protect the beamline and the synchrotron from accidental venting. The principle finding was the ability to discriminate the chemical state of Co atoms in the interior of clusters from those on their surface. The distinguishing feature of these atoms is that the surface atoms have a different chemical state due to charge transfer to ligand molecules that were used to functionalize the nanocrystal surfaces. The technique should find wide application to many future studies, since such functionalization can be used to tailor the properties of new materials for a variety of needs, including magnetism, electronics, and energy collection. ■

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accessible energy range (130–2000 eV) at this beamline. Due to the minute amounts of material needed for STXM experiments (10 fg for a particle), a variety of radioactive materials can be safely studied.

Particulate studies examine differences in the chemical bonding of a particular element. Atmospheric particles collected at ground sites, successively distant from Mexico City, show an increase in the number of particles containing organic carbon (Figure 1). This increased oxidation results from atmospheric processing and influences the particles' water solubility and atmospheric lifetime. The APPES endstation is excellent for probing liquid/vapor and solid/vapor interfaces at Torr pressures. This is ideal for examining the chemistry of interfaces, the role of water, and for probing changes in the interface arising due to chemical reactions. Under identical relative humidity (5%), water wets Cu(110), but not Cu(111) (Figure 2). However, if the Cu(111) surface is partially covered by oxygen, water does wet Cu(111). The wetting is controlled by the presence of OH groups on the surface, acting as anchors for water adsorption. This behavior results from the difference in the dissociation barrier for the two surfaces: Cu(110) < Cu(111). When Cu(111) is partially covered by atomic oxygen, its dissociation barrier is decreased and hydroxylation and water adsorption are observed.

Experimental capabilities at Beamline 11.0.2 are in a constant state of improvement. The endstation area was substantially rearranged to provide optimal space for experiments. Major STXM developments included improved timing schemes for time-resolved experiments, experiments employing fluorescence or electron yield detection as well as progress in tomography and the development of a mini-STXM. Improvements related to the APPES endstation include the development of a separate droplet train apparatus, new material sources, and the addition of new turbopumps. ■

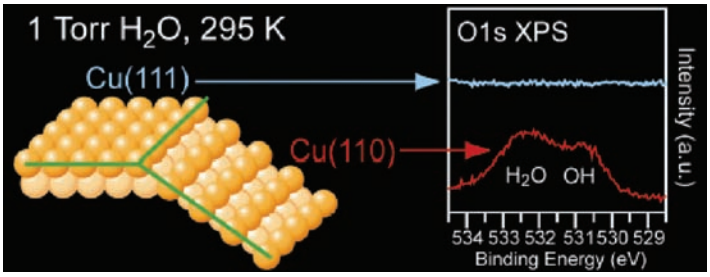

Figure 2. Differences in oxygen bonding between Cu(111) and Cu(110) surfaces (S. Yamamoto et al., *J. Phys. Chem. C* **111,** 7848 (2007)].