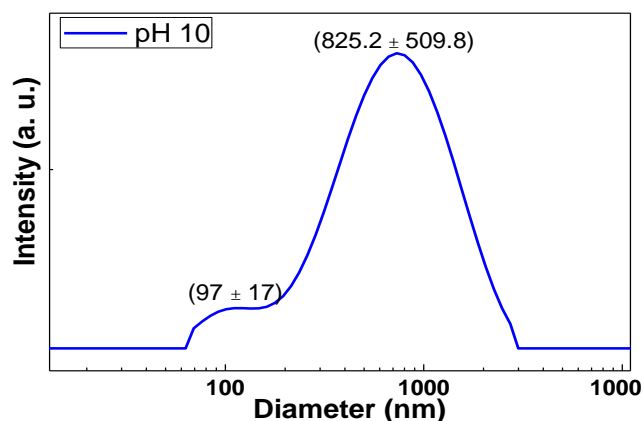


DYNAMIC LIGHT SCATTERING

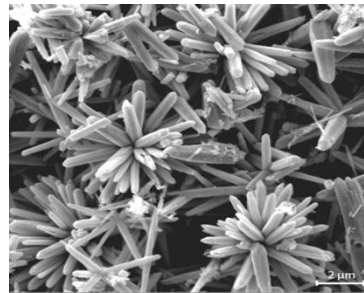
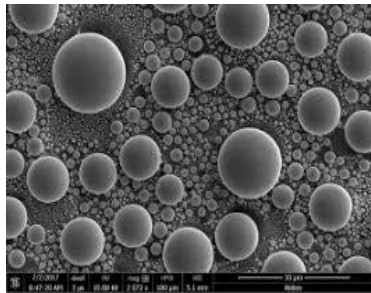
Light from the laser light source illuminates the sample in the cell. The scattered light signal is collected with one of two detectors, either at a 90 degree (right angle) or 173 degree (back angle) scattering angle. The provision of both detectors allows more flexibility in choosing measurement conditions. Particles can be dispersed in a variety of liquids. Only liquid refractive index and viscosity needs to be known for interpreting the measurement results.



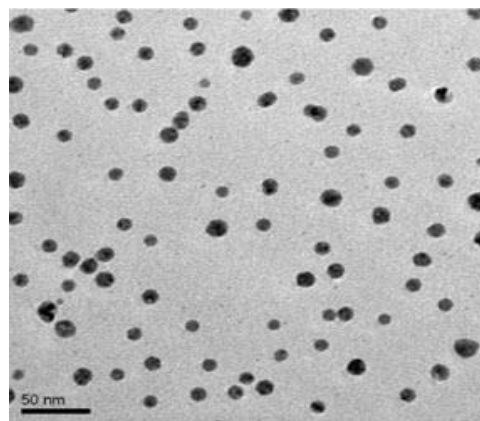
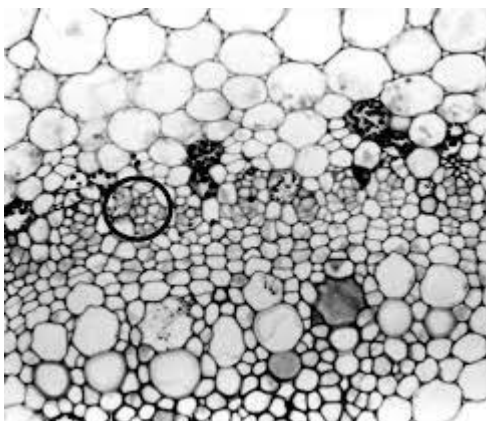
In the intensity distribution of hydrodynamic particle size graph we got 2 peaks, which correspond to particles with different diameters and unequal in number. Particles of larger size (hydrodynamic diameter 825 ± 509 nm) has more intensity than particle with smaller size (hydrodynamic diameter 97 ± 17 nm).

SCANNING ELECTRON MICROSCOPE

A **scanning electron microscope (SEM)** is a type of electron microscope that produces images of a sample by scanning the surface with a focused beam of electrons. The electrons interact with atoms in the sample, producing various signals that contain information about the surface topography and composition of the sample. Specimens are observed in high vacuum in conventional SEM, or in low vacuum or wet conditions in variable pressure or environmental SEM, and at a wide range of cryogenic or elevated temperatures with specialized instruments. SEM samples have to be small enough to fit on the specimen stage, and may need special preparation to increase their electrical conductivity and to stabilize them, so that they can withstand the high vacuum conditions and the high energy beam of electrons. Samples are generally mounted rigidly on a specimen holder or stub using a conductive adhesive. SEM is used extensively for defect analysis of semiconductor wafers, and manufacturers make instruments that can examine any part of a 300 mm semiconductor wafer. Many instruments have chambers that can tilt an object of that size to 45° and provide continuous 360° rotation. SEM images are recorded to find the shape of synthesized nanoparticles.



Transmission electron microscopy (TEM), an abbreviation which can also stand for the instrument, a **transmission electron microscope**) is a microscopy technique in which a beam of electrons is transmitted through a specimen to form an image. The specimen is most often an ultrathin section less than 100 nm thick or a suspension on a grid. An image is formed from the interaction of the electrons with the sample as the beam is transmitted through the specimen. The image is then magnified and focused onto an imaging device, such as a fluorescent screen, a layer of photographic film. Transmission electron microscopes are capable of imaging at a significantly higher resolution than light microscopes, owing to the smaller de Broglie wavelength of electrons. This enables the instrument to capture fine detail—even as small as a single column of atoms, which is thousands of times smaller than a resolvable object seen in a light microscope. Transmission electron microscopy is a major analytical method in the physical, chemical and biological sciences. TEM is capable of returning an extraordinary variety of nanometer- and atomic-resolution information, in ideal cases revealing not only where all the atoms are but what kinds of atoms they are and how they are bonded to each other. For this reason TEM is regarded as an essential tool for nanoscience in both biological and materials fields.



Energy-dispersive X-ray spectroscopy (EDS, EDX, EDXS or XEDS), sometimes called **energy dispersive X-ray analysis (EDXA)** or **energy dispersive X-ray microanalysis (EDXMA)**, is an analytical technique used for the elemental analysis or chemical characterization of a sample. It relies on an interaction of some source of X-ray excitation and a sample. Its characterization capabilities are due in large part to the fundamental principle that each element has a unique atomic structure allowing a unique set of peaks on its electromagnetic emission spectrum (which is the main principle of spectroscopy). To stimulate the emission of characteristic X-rays from a specimen a beam of X-rays is focused into the sample being studied. At rest, an atom within the sample contains ground state (or unexcited) electrons in discrete energy levels or electron shells bound to the nucleus. The incident beam may excite an electron in an inner shell, ejecting it from the shell while creating an electron hole where the electron was. An electron from an outer, higher-energy shell then fills the hole, and the difference in energy between the higher-energy shell and the lower energy shell may be released in the form of an X-ray. The number and energy of the X-rays emitted from a specimen can be measured by an energy-dispersive spectrometer. As the energies of the X-rays are characteristic of the difference in energy between the two shells and of the atomic structure of the emitting element, EDS allows the elemental composition of the specimen to be measured.

