

Influence of surface conductivity on the apparent zeta potential of amorphous silica nanoparticles

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Zeta potential is a physico-chemical parameter of particular importance in describing ion adsorption and double layer interactions between charged particles [1]. However, for metal oxide nanoparticles, the conversion of electrophoretic mobility measurements into zeta potentials is a complex problem. This complexity arises because of their high surface electrical conductivity, which is inversely proportional to the size of the particle [2].

To describe the electrochemical properties of amorphous silica nanoparticles, we use a basic Stern model whose parameters are independently adjusted by potentiometric titration and electrophoretic mobility measurements at high salinity (10^{-1} M NaCl) [3]. At low ionic strengths, because of the strong retardation and relaxation effect due to charged counter-ions at the silica/water interface, amplitude of the predicted zeta potential is significantly higher than that of the apparent zeta potential estimated with electrophoretic mobility measurements and Smoluchowski equation. Electrophoretic mobilities are calculated using Henry's electrokinetic model [4] with the predicted specific surface conductivities and zeta potentials. The very good agreement between calculated and measured electrophoretic mobilities confirms that the magnitude of the true zeta potential corresponds to the magnitude of the electrical potential located at the outer Helmholtz plane. Therefore, the assumption of the presence of a stagnant diffuse layer at the amorphous silica/water interface is not required. This study was done within the framework of the NANOMORPH Project (ANR-2011-NANO-008) coordinated by BRGM.

[1] Lyklema (1991) *Academic Press, London*, 736p. [2] Leroy *et al.*. (2011) *J. Colloid Interface Sci.* **356**, 442-453. [3] Sonnefeld *et al.*. (2001) *Colloids Surf. A: Physicochem. Eng. Asp.* **195**, 215-225. [4] Henry (1948) *Trans. Faraday Soc.* **44**, 1021-1026.

Postcards from Mars: Insights into Martian Geochemical Processes from the Curiosity Rover

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With the successful landing of the Mars Curiosity Rover in August 2012, we now have the most capable geochemical laboratory ever to another planet roving Mars' Gale crater. The geochemical instrument suite includes the Chemistry Camera (ChemCam), which uses a laser to vaporize geologic targets and performs atomic emission spectroscopy on the vapor from distances of up to 7m. This provides a geochemical surveying capability that enables rapid identification of unique specimens and accumulation of a large set of rock and fines compositions as the rover traverses. The Alpha Particle X-ray Spectrometer (APXS) provides high quality "bulk" elemental analyses for major, minor and a few trace elements through a touch deployment on the surface of a rock or soil, and is an upgraded version of similar instruments previously flown to Mars. The addition of x-ray diffraction through the Chemistry and Mineralogy (CheMin) instrument and volatile, isotope, and organic analyses with the Sample Analysis at Mars (SAM) instrument suite, give Curiosity the capability to assess the geochemical history of the planet more deeply than previously possible.

Both CheMin and SAM accept sieved fines from either Curiosity's scoop or drill. To date, sampling has occurred at the Rocknest aeolian drift deposit and a fine-grained mudstone called John Klein. At Rocknest, CheMin found a mix of primary igneous minerals and amorphous materials. SAM found that Rocknest fines contain significant bound volatiles that can be released upon heating, largely associated with the amorphous material. Because APXS and ChemCam data support the fines being representative of those found at other sites on Mars, Curiosity results show that martian fines are a good source of water, CO₂ and other volatiles that could be leveraged by living organisms, including future human explorers. At John Klein, early results are consistent with an ancient aqueous habitable environment. Analyses of isotopes and organics also provide exciting windows into martian habitability and volatile evolution. These early geochemical results will be discussed.