Development of the particle and pore structure of silica below the isoelectric point

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Development of the particle and pore structure of silica below the isoelectric point

Current production of nano-silica
Nano-silica is one of the compounds that is boosting the field of nano-materials with an annual rise of 5.6 % reaching 2.8 million metric tons in 2016 and with a total value of $6.4 billion [1]. The current production methods involve steps with high temperatures. To reach these temperatures huge amounts of fuel are consumed making these processes: a) non-sustainable because of the scarcity of fuels; b) not environmentally friendly because of the huge amount of CO₂ emissions released; and c) expensive because of the fuel price.

Production of olivine nano-silica
Initial research has demonstrated that nano-silica can be produced by dissolving olivine in acid at low temperatures. The acid is neutralized by olivine mineral, according to:

\[(\text{Mg,Fe})_2\text{SiO}_4 + 4\text{H}^+ \rightarrow \text{Si(OH)}_4 + 2(\text{Mg,Fe})^{2+}\]

The neutralization yields a slurry consisting of magnesium/iron salts, silica and unreacted silicates (more details in [2, 3, 4]).

Experimental Methods
Nano-silicas prepared via the olivine route were analyzed to determine their pore structure and specific surface area (SSA) using the nitrogen physisorption, NMR and PALS (positron annihilation lifetime spectroscopy) techniques.

Results
Olivine nano-silica exhibits a SSA_{SET} in the range of 100 to 500 m²/g. The PoSD is in the range of 2 to 100 nm being affected by the process conditions.

References