Langmuir isotherm model applied to surface modification of solid surfaces in liquid environment

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This work presents the isothermal (60^{o} C) silanization of commercial nanoparticles (Aerosil 200, Degussa Co.) in DMF, using pyridine and imidazole as catalysts and evaluating the amount of APTES adsorbed as function of initial APTES concentration (Figure 1). The experimental procedure consists in a single step reaction, where APTES, commercial colloidal SiO_2 (after treatment to remove residual water from surface) and the catalysts were added to DMF pre-heated at 60 ^{o}C. Aliquots were collected after 24 hours and the surface-modified SiO_2 were isolated by centrifugation and washed five times with THF (Tetrahydrofuran) to remove non-reacted APTES. Surface-modified nanoparticles were characterized by DRIFTS, showing that the band at 3740 cm^{-1} (attributed to SiO-H surface bound) disappeared after the time reaction. The graft density, the amount of APTES adsorbed per mass of SiO_2-modified, was determined by elemental analysis and/or thermogravimetry.

The results showed that silanization of commercial SiO_2 nanoparticles fitted the Langmuir isotherm model (Figure 2), which is usually used to determine surface area through gas adsorption on solid surfaces. By this model, it is possible estimates the number of molecules in a monolayer adsorbed in the solid surface and, therefore, molecular density (number of molecules/nm^2) can be calculated.

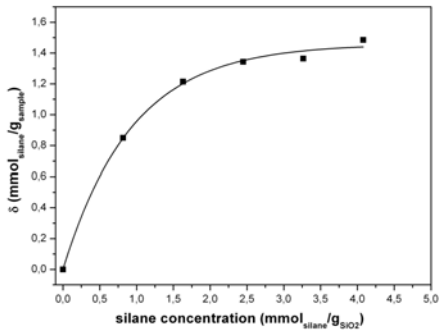

Figure 1 – Isothermal data obtained at 60^{o}C for surface modification of SiO_2.

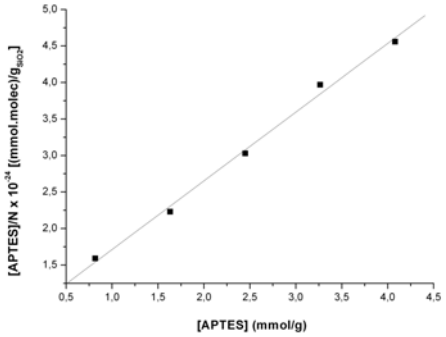

Figure 2 – Langmuir isotherm model applied to isothermal surface modification.

[1] B. T. Thole, P. Carra, F. Sette, G. van der Laan, Phys. Rev. Lett. **68**, 1943 (1992).
[2] M. Tischer, O. Hjortstam, D. Arvanitis, O. Eriksson, Phys. Rev. Lett. **75**, 1602 (1995).

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