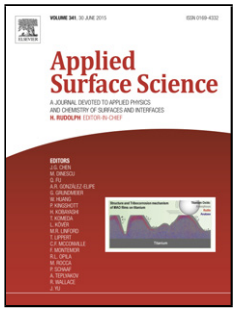

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Nature and morphology of fumed oxides and features of interfacial phenomena

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Highlights
Effects of oxide surface structure on interfacial behavior of nonpolar and polar adsorbates
Confined space effects on freezing and melting temperatures of bound adsorbates
Equilibrium adsorption and evaporation rate vs. structure of nanooxide adsorbents

Abstract
Individual and complex fumed nanooxides were studied using high-resolution transmission electron microscopy, X-ray diffraction, ultraviolet-visible (UV-vis) spectroscopy, differential scanning calorimetry, nuclear magnetic resonance spectroscopy, adsorption, desorption (evaporation), and quantum chemical methods. For mixed nanooxides in contrast to simple and small nanoparticles of individual silica or titania, complex core-shell nanoparticles (50-200 nm in size) with titania or alumina cores and silica or alumina shells can be destroyed under high-pressure cryogelation (HPCG), mechnochemical activation (MCA) that also affect the structure of aggregates of nanoparticles and agglomerates of aggregates becoming more compacted. This is accompanied by changes in color from white to beige of different tints and changes in the UV-vis spectra in the 300-600 nm range, as well as changes in crystalline structure of alumina. Any treatment of 'soft' nanooxides affects the interfacial behavior of polar and nonpolar adsorbates. For some of them, the hysteresis loops become strongly open. Rearrangement of secondary particles affects the freezing-melting point depression. Clusterization of adsorbates bound in pores causes diminution of heat effects during phase transition (freezing, fusion). Freezing point depression and increasing melting point cause significant hysteresis freezing-melting effects for adsorbates bound to oxide nanoparticles. The study shows that complex nanooxides can be more sensitive to external actions than simple nanooxides such as silica.

Keywords
Nanosilica; Mixed fumed oxides; High-pressure cryogelation; Interfacial phenomena; Adsorption; Evaporation