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Some progress in scale inhibition mechanisms understanding, provided by a fluorescent visualization of gypsum scale formation and a special dynamic light scattering technique

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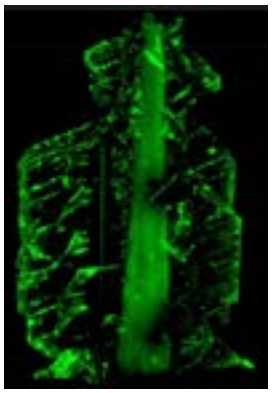
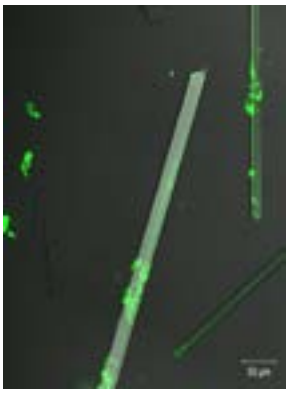
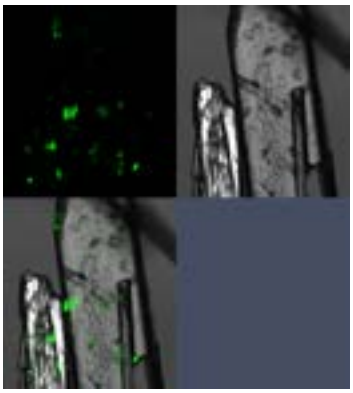
A dynamic light scattering (DLS) special technique is used to study the bulk supersaturated gypsum aqueous solutions during the induction period applying the standard SiO_2 nanoparticles (Ludox TM40) as an indifferent light scattering intensity reference in presence of amino-tris(methylenephosphonic acid), ATMP, hydroxyethanebis(phosphonic acid), HEDP, and a fluorescent-tagged HEDP (F-HEDP) at ambient temperature and pH 9. It is found that all the antiscalants sufficiently reduce the number of gypsum nuclei, spontaneously formed in the supersaturated solutions. A tentative nonconventional mechanism of scale inhibition is proposed. It assumes that the crystal formation centers already exist in any analytical grade aqueous solution in the form of solid nanoimpurities with a size ranging from one to several hundred nm. An antiscalant competes with Ca^{2+} for these centers and blocks them. Therefore the number of gypsum growth centers diminishes significantly. Thus the concentration of corresponding $CaSO_4 \cdot 2H_2O$ particles gets reduced at least 10-fold relative to the blank experiments. A visualization of Gypsum crystals by F-HEDP confirms this conclusion. Fluorescent microscope images of Gypsum crystals formed in a presence of F-HEDP under different conditions. The authors would like to thank the russian foundation for basic research (Project No. 17-08-00061) and partly the russian scientific foundation (project 18-13-00144).

Biography

Graduated from Moscow Lomonosov State University (Inorganic Chemistry), 1972, Moscow. doctoral work 1972-1975; PhD, Moscow Lomonosov State University (Inorganic Chemistry), 1976, Moscow. Postdoctoral work (1984-1985) with prof G Anderegg, inorganic chem department, ETH, Zurich, Switzerland. Dr Sci degree (chemistry) at kurnakov institute of inorganic and general chemistry, moscow, 1992. 1998-2001 titular member of IUPAC. 2000-2001 IUPAC V6 commission secretary. He has published more than 120 papers in journals with a high impact factor and has more than 5 patents and has been serving as expert of russian and bulgarian academies sci.

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