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Synchrotron Radiation
Science
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Abstracts

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Budker Institute of Nuclear Physics of SB RAS
Ministry of Science and Higher Education of the Russian Federation
National Research Centre "Kurchatov Institute"
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Reactions at the solution-gas interface: investigation using synchrotron surface-sensitive methods and the development of new inorganic materials

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The development of new methods for creating hierarchically organized inorganic structures is one of the most important areas of nanotechnology. Interactions at the phase boundaries offer greater opportunities for material design compared to bulk synthesis methods. The liquid-gas interface is mobile, active, and sensitive to diffusion and spatial constraints, which allows us to control the morphology, composition, and structure of the reaction products. The formation of solid compounds at the planar interface between the aqueous solution and a gaseous reactant occurs under “soft” chemistry conditions without complex equipment. In previous studies, inorganic materials with unique morphologies have been successfully synthesized using this approach, such as ordered arrays of particles, gradient and porous films, and scrolls [1]. Various crystalline forms can be synthesized at room temperature, such as the orthorhombic α-PbF_2 and the cubic β-PbF_2, as well as the cubic and hexagonal polymorphs of ScF_3 [2]. Similar reactions have many analogues in nature and engineering, so crystallization pathways at the interface require detailed study. Despite the apparent simplicity of this route, the investigation task is very difficult because only a few physicochemical methods are suitable for this purpose.

Synchrotron methods are successfully used to study Langmuir films, which can form on the surface of water or aqueous solutions of surfactants. Typically, such structures result from the self-assembly of large molecules, such as proteins [3]. Extensive experience in the use and development of synchrotron radiation methods for investigation on liquid surfaces has been accumulated at the Langmuir Station of the Kurchatov Synchrotron Radiation Source “KISI” at the NRC “Kurchatov Institute” [4]. This work attempts to investigate the reactions that occur at the interface when a gaseous reagent (NH_3, N_2H_4, H_2S, etc.) acts on the surface of an aqueous electrolyte solution in the absence of organic molecules, and a solid inorganic film forms as a result.

The presentation will provide examples of nanomaterials that can be produced through chemical interactions at the liquid-gas interface and will explore the potential for studying such chemical reactions using synchrotron techniques.

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