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Fractionation of Sr(II), Th(IV), U(VI) in the natural water samples by nanocomposite track membranes

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Knowledge of the speciation and partitioning of radionuclides and their natural analogs in nature water have great radioecological significance for all environmental systems and Ural region in particular. Distribution of interesting elements in geochemical fractions in water solutions is one of more important point for understanding and modeling mechanism of radionuclide migration in nature water. In this work the method of ultrafiltration was used for determination of fractionation composition of Sr(II), Th(IV), U(VI) in natural basin in the vicinity of the Mayak Production Association (South Urals, RF) [1]. Samples of nature water from the Malishevo lake; Sosnovskoe lake; Techa river, Shelkun lake; Karasie lake, Komarovo pound, Cherviannoe lake was investigated. Sampling of the nature water was carried out in spring (May) 2009 to determine radionuclides and investigate their physicochemical state (speciation). Samples selection and preparation techniques met the recommendations of the Public Health Ministry of the USSR. For the separation of each of the fractions we used the synthesized nanocmposite track membranes NCTMs with conducting titanium oxynitride coating to determine fractionation and chemical composition of suspensions and colloids in natural water. This NCTM were obtained from polymer track membrane by modification of the surface and volume of pore space by deposition inorganic high-strength titanium oxynitride layers with different thickness by the method of ion-plasma sputtering [1]. In this work we used membranes produced in Flerov Laboratory of Nuclear Reactions, JINR (Dubna, Russia) with initial pore size 100 –3000 nm as a precursor to synthesize membranes with advanced chemical and mechanical properties. These coatings make it possible to simultaneously vary the size of the entrance pores within necessary limits (from 100 nm to 1-10 nm) and the physicochemical characteristics of the final composite. NCTMs allowed not only fractionate suspensions, colloids and molecular-ions fractions, but visualized and described natural nano-dimensional objects. By using conducting NCTM we have carried out non-invasive chemical identification of biological and geochemical suspension and colloid materials by means of EM and EDX methods. The NCTM was shown to separate about 10-20 % of Sr(II), Th(IV), U(VI) concentrations from nature water samples with the size >0,1mkm. This fractions consists of Mg-Si-Ca-Fe, CaSO4, biological materials (diatomaceous algae). Our collaborators from IPAE UB RAS have investigate and identified the types of algaes (Figure). It was shone that molecular-ions fractions of the above elements is in the range 80-90 % of their concentrations.

Literature. [1]. Polyakov E.V., Khlebnikov N.A., Surikov V.T., Trapesnikov A.V., Udachin V.N., Remez V.P. Radioprotection. 2009. V. 44. № 5. P. 209-215; [2] N.A. Khlebnikov, E.V. Polyakov, S.V. Borisov, O.P. Shepatkovski, M.V. Kuznetsov, S.V. Smirnov, P.P. Matafonov Development of nanocomposite track membranes modified with titanium oxynitride coating.–Abstracts of Young Researchers Competition, Nanotechnology international forum, 2009, Moscow, RF, p. 336-337.

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