

# Nanochemistry and biotechnology

## The ion exchange properties of nanocrystalline anatase with grafted phosphate groups

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The ion exchange properties of anatase titanium dioxide obtained by sol-gel method using a solution of  $[\text{Ti}(\text{OH})_6]^{3+} \cdot 3\text{Cl}^-$  complex compound as precursor are investigated in the work. The thermostimulated process of water dissociation in the core of complex and increasing of hydroxylation degree of titanium atoms of precursor result in the formation of  $\text{Ti}(\text{OH})_4 \cdot 2\text{H}_2\text{O}$  molecules, which due to condensation converted to  $\text{TiO}_2$  particle of 3-5 nm in size. Chemical grafting of phosphate groupings  $\text{HPO}_4^{2-}$  and  $\text{HPO}_4^-$  on the titanium dioxide surface significantly enhances ion exchange capacity of the sorbent as to heavy metals and strontium.  $\text{TiO}_2$ -sorbent was produced in the form of microspherical xerogel. The concentration of  $\text{SrCl}_2$  in neutral solution (pH = 6,5-7,0) was 0.0001 and 0.01 mol/l. When the weight ratio between water and sorbent was 200, 0.1 and 0.5 mg·eq/g of strontium ions respectively was removed from solution, which was 99 and 55 % of their initial concentration. The partition coefficient of sorbent  $K_d$  were  $3.8 \cdot 10^4$  and  $1.2 \cdot 10^2$  ml/g respectively for these concentrations of  $\text{SrCl}_2$ . Coefficient  $K_d$  is a peculiar figuctor of ion exchanger, which indicates the volume of solution that can be cleaned one gram of sorbent. The sorption value is 2 mg·eq/g when removing of strontium ions from the solution with  $\text{SrCl}_2$  concentration 0.1 mol/l. The sorbent removed 1.5 mg·eq/g of  $\text{Ba}^{2+}$  ions and 1 mg·eq/g of  $\text{Cd}^{2+}$  ions from solutions containing 0.1 mol/l of  $\text{BaCl}_2$  and  $\text{CdCl}_2$ .

Lamellar titanium phosphate  $\text{Ti}_2\text{O}(\text{OH})(\text{PO}_4)[(\text{NH}_2)_2 \cdot \text{PO}_4]$ , similar in chemical nature, removed only 0.2 mg·eq/g of  $\text{Sr}^{2+}$  and  $\text{Ba}^{2+}$  ions from 0.1 M solution of metal nitrate.

Thus, the sorption capacity of ion exchanger obtained significantly exceeding this value for titanium phosphate. It can be used, for example, for water purification from heavy metal ions, strontium, uranium and transuranic elements.