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The Investigation of Interaction PCl_5 with LnCl_3 (Ln – Rare Earth Elements)

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The data about possibility of the interaction between chlorides phosphorus and earth metals in science literature are absent

We have investigated the interaction of vapours PCl_5 with melts LaCl_3 , CeCl_3 , PrCl_3 , SmCl_3 , GdCl_3 , TbCl_3 , ErCl_3 , YbCl_3 , YCl_3 and ScCl_3 as well as molten PCl_5 with enumerating solid LnCl_3 . The reactions were conducted in the soldered quartz ampoules with temperatures 330-950 °C and pressure of vapours to 35 atm. The products of the interactions (in the glass hermetic microcuvettes) were studied under microscope of Raman spectrometer Microprobe MOLE (using an Ar^+ laser power up to 600 mW with $\lambda = 514,5 \text{ nm}$).

Pentachloride of phosphorus in described conditions has been well established as interacting with all of studied LnCl_3 . In Raman spectra of reaction products the intensive lines of complex cation $[\text{PCl}_4]^+$ (T_d): $\nu_1(A_1) \sim 453$, $\nu_2(E) \sim 175$, $\nu_3(F_2) \sim 653$ and $\nu_4(F_2) \sim 249 \text{ cm}^{-1}$, lessintensive lines of anion $[\text{LnCl}_6]^{3-}$ were fixed. The bands of anion $[\text{PCl}_6]^-$ were not discovered. It is obvious, twofold compounds contain complex chloride cation of phosphorus and anion of lantanoide (III).

For the first time, the reaction PCl_5 with CeCl_3 (unlike from another LnCl_3) has been established to lead stabilization of not stable 4-valence cerium state. The double compound maintains complex cation $[\text{PCl}_4]^+$ and anion $[\text{CeCl}_6]^{2-}$ (O_h) with bands in Raman spectrum: $\nu_1(A_{1g}) \sim 300$, $\nu_2(E_g) \sim 210$ (weak) and $\nu_3(F_{2g}) \sim 125 \text{ cm}^{-1}$.