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Complexation of a novel multidentate chelating agent “N2S2O2/N4O2” with Po(IV)

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Polonium is a highly radiotoxic element, whose main hazard comes from ingestion or inhalation. One of polonium’s isotopes, polonium-210 (Po-210) exists naturally from the uranium-238 decay. 20% of the annual effective dose of Po-210 comes from inhalation of uranium and thorium radionuclides and 60 % from ingestion. To illustrate the radiotoxicity of Po-210, one may note that 1 µg of Po-210 emits as many alpha particles as 446 kg of uranium-238. Although Pierre and Marie Curie discovered the polonium (Po) element more than a century ago, physico-chemical properties of this element and its compounds and in particular complexes are still barely known. This can be explained by two main reasons: first, polonium is very rare in nature, being found in uranium ores at approximately a ration of 100 µg/ton. Thus, an adapted cyclotron or a reactor is necessary to produce some of its isotopes. Second, polonium has thirty five known isotopes, all of which are radioactive. However, a better understanding of polonium’s affinity with organic or inorganic ligands is essential to improve techniques of biological decorporation or environmental remediation. In this context, there is a need in designing specific decorporating agent for polonium, having a high affinity for this element at a given oxidation degree. A novel water soluble multidentate “N2S2O2/N4O2” ligand complexing agent was designed and synthesized, as a potential new water soluble - selective chelating agent for possible polonium decorporation. This ligand presents a priori ideal characteristics for polonium complexation, i.e. a platform presenting four soft heteroatoms (N/S) and additional two pendant carboxylic groups to complete the octahedral coordination shell suitable for polonium (IV) complexation. Its affinity for polonium was studied at pH=7.4 using a liquid-liquid extraction methodology. In parallel, theoretical calculations were applied to understand more specifically the nature of the “microscopic” interactions of polonium(IV) with the functional groups of the synthesized ligands.

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