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**ADVANCED ORIENT CYCLE, FOR STRATEGIC SEPARATION, TRANSMUTATION AND UTILIZATION OF NUCLIDES IN THE NUCLEAR FUEL CYCLE****Masaki Ozawa<sup>\*1,3</sup>, Reiko Fujita<sup>2</sup>, Shinichi Koyama<sup>1</sup>, Tatsuya Suzuki<sup>3</sup>  
and Yasuhiko Fujii<sup>3</sup>**<sup>\*1</sup> Japan Atomic Energy Agency<sup>\*2</sup> Toshiba Corporation<sup>\*3</sup> Tokyo Institute of Technology, Japan

E-mail: ozawa.masaki@jaea.go.jp

**ABSTRACT**

Electrolytic extraction (EE) method has been studied as a vital separation tool for new reprocessing process to realize transmutation and utilization of the specific fission products including LLFP\* (e.g., Tc\*, Ru, Rh, Pd\*, Se\* and Te\*, etc) in the spent nuclear fuel. In an employed EE process, Pd<sup>2+</sup> cation itself would not only be easily (>99%) deposited from various nitric acid solutions, but enhance also the deposition of co-existing RuNO<sup>3+</sup> and ReO<sub>4</sub><sup>-</sup> by acting as a catalyst (as Pd<sub>adatom</sub>). Such a catalytic electrolytic extraction (i.e., CEE) method was also applicable in the case of <sup>99</sup>TcO<sub>4</sub><sup>-</sup> deposition as well. Addition of Pd<sup>2+</sup> caused either to change the dendritic metal deposition form or to improve electrochemical property of deposits. The RMFP deposit, especially quaternary-, Pd-Ru-Rh-Re, deposits on the Pt electrode obtained by the CEE method were rather spherical in shape, seemed to be electrochemically agglomerated by nano particles. The deposits were stable and showed electrochemically nobler initial hydrogen evolution potential ( $\phi_{\text{Hint}}$ ). Also in the given potential of -1.25V (vs. Ag/AgCl), the quaternary-, Pd-Ru-Rh-Re, deposit Pt electrode suggested the highest cathodic current corresponding to the hydrogen generation reaction. Namely, those catalytic activities were ca. twice superior to that of the Pt electrode in alkaline solution. The sea water is a possible resource for hydrogen production in future. In the course of sea water electrolysis, disturbance due to Ca(OH)<sub>2</sub> and Mg(OH)<sub>2</sub> precipitation was inevitable, but the cathodic current of the quaternary deposit of RMFP was the highest, the same as to that of Pt electrode in the alkaline water. Therefore, RMFP has a potential to alternate with Pt catalyst. The electrochemical property of Re and <sup>99</sup>Tc, as for alternative element to Re, are under investigation with a special interest of this direction of utilization. The renovative reprocessing flow sheet by tertiary pyridine resin which enables to directly recover pure Cm as well as pure Am with minimum number of reprocessing separation steps is reported in another paper. The recent experiments indicated that strong adsorption of <sup>106</sup>Ru and <sup>125</sup>Sb was observed under the diluted HCl medium, thereby completely <sup>106</sup>Ru-free feed dissolver solution was obtained. The CEE separation step will follow this IX step for further purification and fabrication of RMFP material for their utilization. Based on those technologies, the Trinitarian R&D project (Advanced ORIENT Cycle) on partitioning, transmutation and utilization of actinides and fission products will be developed to realize ultimate reducing long-term radio toxicity in the radioactive wastes. Actinides, LLFP (<sup>135</sup>Cs, etc), MLFP (<sup>90</sup>Sr, <sup>137</sup>Cs) and RMFP shall be separated to the level of isotope as well as element. The CEE process will be added for utilization of RMFP. The RMFP, one of the products of Ad. ORIENT Cycle, would be expected to be a "FP-catalyst" to circulate between nuclear and hydrogen / fuel cell energy systems, and thereby contributing to save the natural precious metal resources.