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Production of the 186mRe isomer in nuclear reactor

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The nuclear isomeric state ^{186m}Re with an energy of 149 keV and a half-life of 2×10^5 years is of great interest for experiments on the stimulation of de-excitation of nuclear isomers in plasma [1, 2]. In this work, the possibility of reactor production of a substance with a high concentration of ^{186m}Re isomer is considered. A cross section of about 0.3 barn of excitation of the ^{186m}Re isomer by the thermal neutrons capture by ^{185}Re nuclei was obtained in [3]. Compared to this reaction, the excitation of the ^{186m}Re isomer in inelastic neutron scattering by ^{186}Re nuclei in the ground state, decaying with a period of 90 hours, or in (n, 2n) reactions on the ^{187}Re isotope is not significant.
This conclusion corresponds to the production of the ^{186m}Re isomer in 2006 at the WWR-M reactor at the Petersburg Nuclear Physics Institute, when the metal powder of natural rhenium was simultaneously irradiated in the B-8 channel (thermal neutrons) and in the reactor core, where the neutrons were more high-energy. Within the measurement error of the neutron fluence for both samples, the isomer production was proportional to the fluence of thermal neutrons with an isomer cross section of 0.29 ± 0.06 barn (error at the level of one standard deviation), which coincides with the result of [3].
Thus, to produce the isomer, the ^{185}Re isotope should be placed in the thermal neutron flux. The exposure is limited to the burn-up of the ^{185}Re isotope and the produced ^{186m}Re isomer. The production of the ^{186m}Re isomer is maximum at a neutron fluence of Φmax ≈ 2×10^{22} cm^{-2}, while the number of ^{186m}Re nuclei is 0.2% of the starting number of ^{185}Re nuclei. To obtain material of the pure ^{186m}Re isomer, it is first possible to clean the irradiated rhenium from chemical impurities on an ion-exchange column and then isolate an isotope with a mass number of 186. This will be the practically pure ^{186m}Re isomer, since ^{186}Re nuclei in the ground state decay quickly. For this operation, gas-centrifuge separation of rhenium isotopes in the form of hexafluoride, the boiling point of which is only 33.7℃, is promising.
Interestingly, a pure ^{186m}Re metal will essentially be a new state of matter.

1. V.V.Vatulin, N.V.Jidkov, A.A.Rimsky-Korsakov et al. // Bull. Russ. Acad. Sci: Phys. 2017. V. 81. № 10. P. 1159.
2. V.V.Koltsov. "On stimulation of nuclear isomer de-excitation in plasma of electric explosion of conductors". Proc. Int. Conf. "Nucleus-2018"- 68th Meeting on Nuclear Spectroscopy and Atomic Nucleus Structure. Voronezh, Russia July 2-5, 2018. P. 127.
3. D.W.Seegmiller, M.Linder, R.A.Meyer // Nucl. Phys. 1972. V. A185. P. 94.

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