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Prospects for plasma excitation of 186mRe nuclear isomer

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In [1], a laser plasma with electron temperature Θ_e ~ 1 keV and the lifetime of $\tau \approx 0.5$ ns was formed from rhenium metal containing ^{186m}Re isomer nuclei ($T_{1/2}$ = 2×10^5 years) with an isomer concentration of ~ 10^{-3} %. In this plasma the stimulated de-excitation of ~ 10^{-5} % isomeric nuclei was observed. The experimental results made it possible to assume in the ^{186}Re nucleus at an energy of a slightly higher isomer energy the existence of a previously unknown level to which a trigger transition occurs upon stimulation of de-excitation of the ^{186m}Re isomer. Later this assumption was supported by the study of the decay curve of ^{186}Re nuclei produced in the (p, n) reaction on ^{186}W nuclei [2].
Only a weak effect was observed in [1], and for its amplification, a technique was proposed for the reactor production of the ^{186m}Re isomer to a concentration of ~ 0.1 % and a technique for isolating the pure ^{186m}Re isomer as a separate phase. Also instead of a laser plasma it was proposed to use a high-current electric discharge plasma, the lifetime of which increases to ~ 50 ns while maintaining the plasma temperature Θ_e ~ 1 keV [3].
To further enhance the stimulation effect, the irradiation of plasma, containing isomeric nuclei, by the photons resonant to the trigger transition was proposed [4], however, for this, it is first necessary to determine the energy of the trigger transition. In this work, the plasma itself is considered as a source of resonant irradiation when atoms with resonant characteristic X-ray radiation are introduced into it. With an increase in the lifetime of the discharge plasma and with resonant photon irradiation of ^{186m}Re atoms, the probability of de-excitation of the ^{186m}Re isomer in the plasma can be increased by four orders of magnitude compared to [1].
The results already give grounds for the development of a power unit based on the stimulated de-excitation of the ^{186m}Re isomer with the following parameters: specific energy capacity ~ 10^8 J/g, specific operating power ~ 1 kW/g, specific storage power ~ 70 μW/g.

1. V.V.Vatulin, N.V.Jidkov, A.A.Rimsky-Korsakov et al. //Bull. Russ. Acad. Sci.: Phys. 2017. V. 81.No 10. P. 1159.
2. V.V.Karasev, V.V.Koltsov, A.A.Rimskii-Korsakov // Bull. Russ. Acad. Sci.: Phys. 2018. V. 82. No. 10. P. 1237.
3. 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.
4. V.V.Koltsov // Bull. Russ. Acad. Sci.: Phys. 2019, V. 83, No. 9, P. 1141.

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