^{242m}Am Isomer Yield in ^{243}Am(n,2n) Reaction

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The reaction ^{243}Am(n,2n) populates either the $T_{1/2}$ =16h ground state ^{242g}Am with $J^{\pi}=1^{-}$ or the ^{242m}Am isomer state $J^{\pi}=5^{-}$ with $T_{1/2}$ =141y. The former state ^{242g}Am mostly β^{-}-decays to ^{242}Cm [1] or goes to ^{242}Pu via electron capture. The yield of the ^{243}Am(n,2n)^{242g}Am(β^{-}(ε)^{242}Cm(^{242}Pu) influences the α–activity and neutron activity of the spent fuel due to emerging nuclides ^{242}Cm and ^{238}Pu. The yield of the ^{242m}Am long-lived isomer state, which due to large and odd value of $J^{\pi}=5^{-}$ may decay to ^{242g}Am via isomeric transition only, gives a path for the ^{244}Cm yield via ^{242m}Am(n,γ)^{243}Am(n,γ)^{244m}Am(β^{-}(ε) ^{244}Cm(^{244}Pu) or ^{242m}Am(n,γ)^{243}Am(n,γ)^{244g}Am(β^{-}) ^{244}Cm. If not the forbidden β^{-}-decay of ^{242m}Am state, the major path for the ^{244}Cm accumulation would not exist. A number of discrepancies are observed in Fig. 1 and Fig. 2.

Calculated yields of ^{242g}Am and isomer ^{242m}Am states of the residual ^{242}Am nuclide are applied to predict the branching ratio $R(E_n)=\sigma^{m}_{n2n}(E_n)/(\sigma^{g}_{n2n}(E_n)+\sigma^{m}_{n2n}(E_n))$ (Figs. 1, 2). The branching ratio defined by the ratio of the populations of the lowest states. These populations defined by the γ-decay of the excited states, described by the standard kinetic equation. The absolute yield of ^{242g}Am is compatible with the measured data [1]. The ordering of the low and high spin states is different in case of ^{236}Np and ^{242}Am, that explains different shapes of $R(E_n)$ near the (n,2n) reaction threshold, though the excitation energy dependences are similar.

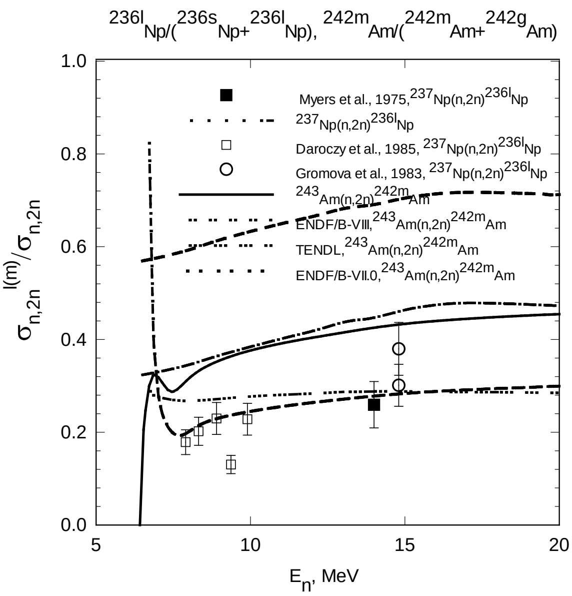

Fig.1. Relative yield of long-lived (5^{-}) ^{242m}Am state in ^{243}Am(*n*,2*n*) reaction.

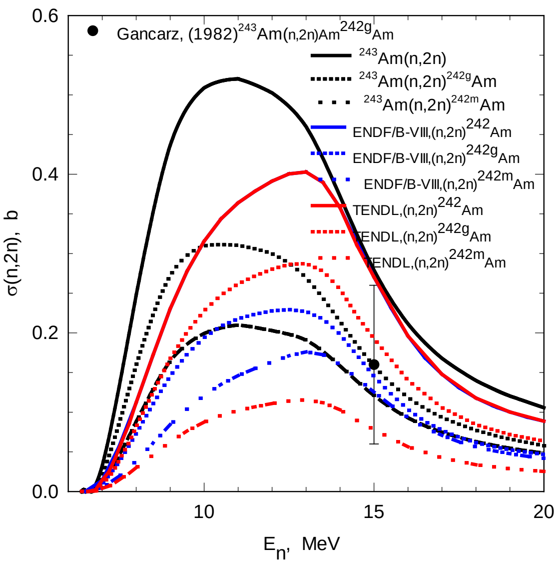

Fig.2 Cross sections of ^{243}Am(*n*,2*n*), ^{243}Am(*n*,2*n*) ^{242m}Am and ^{243}Am(*n*,2*n*) ^{242g}Am.

1. T.L. Norris, A.J. Gancarz, D.W. Efurd, R.E. Perrin, G.W. Knobeloch, P.W. Oliver, G.F. Grisham, R.J. Prestwood, I., Binder, G.W. Butler, W.R. Daniels, and D.W. Barr. 14-MeV (n,2n) Neutron Cross Sections of ^{241}Am and ^{243}Am. In: Irradiations at the Rotating Target Neutron Source-II, p. 69. UCID-19837-83.