k₀-MEASUREMENTS AND RELATED NUCLEAR DATA COMPILATION FOR (n, γ) REACTOR NEUTRON ACTIVATION ANALYSIS

IIIb: TABULATION

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k₀-factors and related nuclear data are tabulated for 112 radionuclides of interest in (n, γ) reactor neutron activation analysis. Whenever relevant, critical comments are made with respect to the accuracy of literature data for e.g. isotopic abundances, half-lives, absolute gamma-intensities and 2200 m⁻² s⁻¹ (n, γ) cross-sections. As to the latter, a comparison is made with the values calculated from the experimentally determined k₀-factors, by introduction of selected literature data for the input parameters.

Introduction

In a separate paper (Part IIIa), details are given on the experimental determination of accurate k₀-factors, totalling now — together with the data published earlier — results for 112 analytically interesting radionuclides. In the present paper (Part IIIb) a user-oriented tabulation is given of data for all essential input parameters, including, in addition to the k₀-factors, half-lives, Q₀-and E₀-values, and some other nuclear constants in case of complex activation and/or decay (for the explanation of symbols, see Part IIIa).

In the same way as in the former papers of this series, it was felt interesting to make a comparison with k₀-factors calculated systematically from nuclear data quoted in some compilations frequently referred to. Indeed, this reveals the situation with respect to accuracy and traceability when performing “absolute” NAA without nuclear data control.

Contrary to previous tabulations it is not tried now to select from literature the nuclear data (Θ, γ, σ₀) which are giving the smallest discrepancy between the

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calculated and the measured $k_0$-factors, since this might sometimes lead to a choice of rather "exotic" values. Instead, the "activation method" for $\sigma_0$-determination is applied in exactly the same way as previously reported in detail for $^{50}$Cr$(n,\gamma)\ ^{51}$Cr, $^{64}$Zn$(n,\gamma)\ ^{65}$Zn, $^{154}$Sm$(n,\gamma)\ ^{155}$Sm, etc. This necessitated a careful selection from literature of the input nuclear data ($\Theta,\gamma$), which are tabulated together with the fully correlated $\sigma_0$-results. Finally, this literature study threw light upon the state of affairs with respect to the reliability and consistency of published nuclear data.

Contents of the tabulation

Columns 1 to 13 of Table 1 contain the following information (see Refs to Table 1):

1. line 1: symbol of the element; line 2: atomic mass $M$, for calculation of $k_0$ (column 12) and $\sigma_0$ (this work; column 4, line 2); line 3: thermal cross-section ($\sigma_{abs}$) and resonance integral ($I_{abs}$) for neutron absorption, taken from the Chart of the Nuclides, GEC, 13th ed., 1984;

2. target isotope;

3. isotopic abundance $\Theta,\%$; line 1: as quoted by MUGHABGHAB et al., NNDC/BNL, 1981 (for $Z=1-60$)/1984 (Z=61-100), for $k_0$-calculation (column 12); line 2: from the most recent IUPAC/SAIC-evaluation (DE BIEVRE et al., 1985), with uncertainty ($\%$, full or dashed underlining if better or worse than 10%), as input for $\sigma_0$-calculation in this work (column 4, line 2);

4. 2200 m s$^{-1}$ $(n,\gamma)$ cross-section $\sigma_0$, barn, with uncertainty ($\%$); line 1: same as column 3, line 1; line 2: obtained in this work, with Au as the ultimate standard, from $M$ (column 1, line 2), $\Theta$ (column 3, line 2), $\gamma$ (column 11, line 2), and — in some cases of complex activation/decay$^1$ — from fractional decay factors $F$ (column 8) [uncertainty quotation and underlining of $\sigma_0$'s is done only when arising from "recommended" $k_0$'s, involving then a weighted mean calculation (with only uncorrelated uncertainties as weighing factors) of $\sigma_0$'s for each gamma (column 13, line 2) and adopting the larger of the internal or external error; in short, final uncertainties are obtained from quadratic combination of random (experimental) ones with uncertainties originating from the input data; underlining is full or dashed if the uncertainty is better or worse than 10%; in addition to Au, also Mn and Co are considered as cross-section standards];

5. $(n,\gamma)$ resonance integral $I_0$, barn ($E_{Cd} = 0.55$ eV), with uncertainty ($\%$); line 1: as quoted by MUGHABGHAB et al., 1981/1984; line 2: as obtained in this work from multiplication of $\sigma_0$ (column 4, line 2) by $Q_0$ (column 6, line 2) [the uncertainty, if specified, is obtained from quadratic combination of the uncertainties