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Technical Notes

The Total Neutron Cross Section of Palladium from 0.005 to 10 eV*

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The total neutron cross section of palladium has been measured from 0.005 to 10 eV utilizing the fast neutron chopper at MIT with the MIT Reactor (MITR) as the neutron source[1]. A resonance, which has been ascribed to ^{108}Pd by Coceva et al[2], was found at 2.97 ± 0.06 eV. The cross section at the resonance was determined to be 14.3 ± 1.6 b. The observed resonance width Γ has been determined from our measurements to be 93 mV, which is in good agreement with the 90 ± 2 mV value quoted by Coceva et al.[2]. The work presented here provides new cross-section data for palladium, and supplements the data of other authors in the slow and eV neutron energy ranges[2-6].

The cross section was measured in a transmission experiment by the time-of-flight method, using the MITR fast neutron chopper which was originally constructed at the Chr Michelsen Institute in Norway. The chopper consists of a 49-cm-diam rotating lucite rotor with eight slits, each 0.5-mm wide at the inlet, to produce the neutron bursts. The flight path of 25.83 m led to a bank of Reuter-Stokes BF_3 tubes used as the detector. The signal was transmitted to a 256-channel time-of-flight analyzer, manufactured by the Technical Measurement Corporation.

The samples were 99.97% pure palladium (as determined by spectroscopic analysis) rolled to the desired thicknesses. Satisfactory counting rates were obtained by using sample thicknesses of 0.035×10^{24} and 0.140×10^{24} atoms/cm^2. The open beam and sample inserted count-rates were corrected for deadtime counting losses, background, and reactor power fluctuations. Corrections for sample impurities and multiple scattering were negligible. The resolution of the system varied from about 0.4 to 6.5 μsec/m, for rotor speeds from 3050 to 130 rpm. The cross-section uncertainty (15%) arose primarily from statistics (13%) and from background (7.5%).

The measured total neutron cross section of Pd is presented in Fig. 1. For each energy interval, only the data from the run having the highest resolution is shown; however, the agreement in the overlap region between runs is very good. The energy uncertainty is indicated in Fig. 1 as the full-width at the half-maximum of the symbolic resolution triangles. In regions where the cross section has been measured by other workers, the agreement with our results is excellent.

A resonance at 2.97 ± 0.06 eV was found, and its cross section was measured to be 14.3 ± 1.6 b. Between 0.005 and 0.05 eV, the cross section σ is satisfactorily described by the relationship $\sigma = A + BE^{-1/2}$, where E is the neutron energy, and A and B are parameters. Experimental values of A and B satisfying this relationship (obtained by a least-square calculation) are given as A = 6.2 b, and B = 0.78 eV$^{1/2}$ b.

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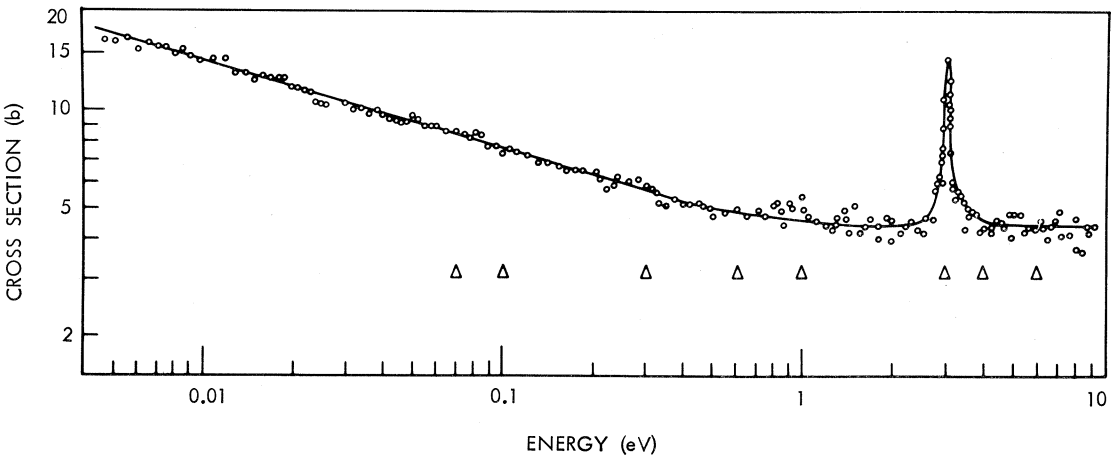

Fig. 1. The total neutron cross section of palladium (in b) as a function of energy (in eV). A resonance of 14.3 ± 1.6 b occurs at 2.97 ± 0.06 eV. The energy uncertainty is indicated as the full-width at the half-maximum of the symbolic resolution triangles.