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Direct measurement of cross sections for the ^{114}Cd(n,γ) reaction with En = 1 eV to 300 keV using DANCE

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Cadmium has many practical applications where significant thermal neutron fluences are expected, owing to the large thermal capture cross-section of ^{113}Cd. This feature has led to many applications that use cadmium to screen these thermal neutrons. Once such field where this is utilized is in non-destructive assay techniques that employ cadmium liners to interrogate spent fuel assemblies, such as Passive Neutron Albedo Reactivity. Measuring capture cross sections on the even cadmium isotopes is challenging, since the odd-mass capture products have low-lying isomers that can complicate the analysis. Capture cross section data for the cadmium isotopes exist for thermal energies, but at most other energies the experimental information on cadmium is relatively poor, save for data taken in the kT = 15 to 100 keV energy regions relevant to the calculation of Maxwellian averaged cross sections related to the astrophysical s-process. For ^{114}Cd, there are two sets of cross section data in the regions of E$_n$ = 3 keV to 100 keV [1,2] that do not agree within uncertainty, yet these differences manifest in the choice of cross section evaluation used for these neutron energies, as the ENDF follows closely the data found in Ref. [1] while the JENDL follows closely the data found in Ref. [2]. There is no direct cross section measurement of any resonances published on ^{114}Cd(n,γ).
To address these issues, direct measurements of neutron capture cross sections were performed at the Los Alamos Neutron Science Center (LANSCE) using the Detector for Advanced Neutron Capture Experiments (DANCE). A highly enriched (~99%), 100 mg pressed pellet target of ^{114}Cd was used to perform the neutron capture measurements in the range of E$_n$ = 1 eV to 300 keV using LANSCE's white neutron source. Neutron capture data were also taken on highly enriched targets of ^{112,113}Cd to enable careful background subtraction of even the small contaminants found in the ^{114}Cd target. By using large energy sum windows around the Q-value, our analysis largely circumvents any complication that may arise from population of the 180 keV isomer (T$_{1/2}$ = 44.56 d) in ^{115}Cd. Results on the cross sections for the ^{114}Cd(n,γ) reaction will be presented.
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[1] A. de L. Musgrove et al., J. Phys. G 4, 771 (1978).
[2] K. Wisshak et al., Phys. Rev. C 66, 025801 (2002).

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