

ABSTRACT

The neutron capture cross sections of ^{176}Hf , ^{177}Hf , ^{178}Hf , ^{179}Hf , and ^{180}Hf have been measured in the energy range from 3 to 225 keV at the Karlsruhe 3.7 MV Van de Graaff accelerator. Neutrons were produced via the $^7\text{Li}(p, n)^7\text{Be}$ reaction by bombarding metallic Li targets with a pulsed proton beam. Capture events were registered with the Karlsruhe 4π Barium Fluoride Detector, and the cross sections were determined relative to the gold standard. The measurements were performed on highly enriched hafnium oxide samples. The respective cross section ratios could be obtained with overall uncertainties between 0.9 and 1.8%, about a factor of five more accurate than previous data. Partial cross sections to ground and isomeric states could be experimentally identified for neutron capture in $^{176,177,178,179}\text{Hf}$ indicating a strong population of yet unknown isomeric states in ^{177}Hf and ^{180}Hf . This feature was further confirmed by extensive GEANT simulations, using theoretically calculated capture cascades based of the known level schemes. Maxwellian averaged neutron capture cross sections were calculated for thermal energies between $kT = 8$ keV and 100 keV. For three isotopes the results agree fairly well with a recent evaluation, while the other cases differ by 13 to 37%.