Neutron activation measurements on natural Ge and Hf

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The (n,p), (n,α) and (n,2n) reactions are of particular importance in the investigation of the compound nucleus evaporation mechanism. Furthermore, the measurement of isomeric to ground state cross section ratios for the formation of residual nuclei, has attracted considerable attention in recent years. The yield to the high spin isomer in the product nucleus, appears in the calculations to be strongly dependent on the level scheme and the spin distribution of the level density. These are the main motivations for the measurements of neutron induced reaction cross sections on Ge and Hf isotopes. In the case of Ge there is an additional technological interest related to the radiation damage of HPGe detectors. Cross section measurements of neutron induced reactions on natural targets of Ge and Hf have been carried out at the 5.5 MV Tandem accelerator of the NCSR "Demokritos" in Athens, Greece, using the activation method. The measurements were performed at neutron energies 8.8, 9.7, 11.1, 11.5, 17.2 and 17.8 MeV. For the former four energies the ^{2}H(d,n)^{3}He reaction was used as neutron source, while for the last two, the neutrons were produced using the ^{2}H(t,n)^{4}He reaction. A BF_3 detector was used to monitor the neutron beam flux, while the absolute flux at the target position was determined by means of the reference reactions ^{27}Al(p,α)^{24}Na, ^{93}Nb(n,2n)^{92}Nb and ^{197}Au(n,2n)^{196}Au. The γ-ray transitions emitted from the activated targets were detected by two HPGe detectors of relative efficiency 80% and 55%, in order to deduce cross sections of ^{72}Ge(n,p)^{72}Ga, ^{73}Ge(n,p)^{73}Ga, ^{72}Ge(n,α)^{69}Zn^{m}, ^{74}Ge(n,α)^{71}Zn^{m}, ^{70}Ge(n,2n)^{69}Ge, ^{76}Ge(n,2n)^{75m,g}Ge, ^{174}Hf(n,2n)^{173}Hf, ^{176}Hf(n,2n)^{175}Hf and ^{180}Hf(n,n' γ)^{180}Hf, reactions. Theoretical calculations based on the Hauser - Feshbach statistical model have been performed by using the codes STAPREH95 and EMPIRE (version LODI) and were found to be in good agreement with the experimental data.