Optical potentials for alpha particles on heavy nuclei around the Coulomb barrier

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A semi-microscopic analysis of only α-particle elastic scattering on A~100 nuclei at energies from ~14 to 32 MeV provided also a phenomenological optical model potential1,2 (OMP) which describes well the (α,n) reaction data for lighter target nuclei with A<54 but led to a major overestimation of similar cross sections3 for heavier nuclei. Better results were provided in the later cases by either the well-known four-parameter global potential4 of McFadden-Satchler or also a simpler potential5, while even the α-particle potential of Galaviz et al.6, which was deduced from the a-particle elastic scattering on 112Sn at energies close to the Coulomb barrier, only poorly describes the α-capture data3 at energies below 6 MeV. Similar questions are raised by rather recent analyses7 for target nuclei with A=63-118. A global α-nucleus OMP is proposed by the BARC group8 for A~12-209 and energies from Coulomb barrier up to about 140 MeV, based on a previous systematics of the real and imaginary potential volume integrals. The BARC global potential was found to describe well the high energy elastic-scattering data, while at lower energies the calculations and the data differ considerably. An ultimate assessment of (α,γ), (α,n) and (α,p) reaction cross sections for target nuclei from 45Sc to 118Sn, and incident energies below ~12 MeV, have found responsible for the actual difficulties the former diffuseness of the real part of optical potential as well as the surface imaginary-potential depth. Thus an optical potential which describes equally well both the low energy elastic-scattering and α-particle induced-reaction data was obtained9 and confirmed10 by analysis of additional reaction data. The recent high precision measurements of α-particle elastic-scattering make possible further improvement of global OMPs. We have looked in this respect for an extension of the previous semi-microscopic analysis based on the Double Folding Model to the mass region 50<A<209 nuclei and energies from ~13 to 50 MeV. The energy-dependent phenomenological imaginary part for this semi-microscopic optical potential was obtained including the dispersive correction to the microscopic real potential, and used within a concurrent phenomenological analysis of the same data basis. A global parameter set for low-energy α-particles entirely based on elastic-scattering data analysis was thus obtained for the nuclei within the above-mentioned mass and energy ranges, and next involved in the reaction data analysis.