Fusions of $^{32,34}S+^{112,116,120,124}Sn$: effects of positive *Q*-value neutron transfers

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Sub-barrier fusion offers an ideal opportunity for exploring two fundamental mechanisms in quantum physics: coupling and tunneling. It has been well known that channel couplings greatly change the tunneling processes and largely enhance the sub-barrier fusion cross sections. Up to now, couplings to collective vibrational and/or rotational states can be well understood in the framework of microscopic coupled-channels (CC) theory, for instance, the CCFULL model. However, couplings to transfer channel, a typical process of nucleon rearrangement, remain hazy. It was proposed that couplings to positive *Q*-value neutron transfer (PQNT) will result in a large enhancement of fusion cross sections at sub-barrier energies. Nevertheless, the experimental results are contradictory. For example, large enhancements were observed in $^{32}S+^{94,96}Zr$ but not in $^{58,64}Ni+^{118,124,132}Sn$ systems. The Sn isotopes, as neutron-superfluidity nuclei, may play special roles in the latter cases. In order to confirm this idea, fusion excitation functions of $^{32,34}S+^{112,116,120,124}Sn$ systems were measured at near- and sub-barrier energies. Meanwhile, angular distributions of elastic scattering were measured to constraint the parameters of optical model potentials used in the calculations. The *Q*-values of neutron transfer for these systems are changed with the asymmetry of projectile and target combinations. Taking 2n transfer as example, Q_{gg} values vary from -2.08 MeV for $^{34}S+^{112}Sn$ to 5.63 MeV for $^{32}S+^{124}Sn$. Results show that experimental fusion cross sections can be reasonably reproduced by the CCFULL calculations when the inelastic excitations are considered, and couplings to PQNTs play a minor role in fusions. Details of the experimental procedure, theoretical calculations, and discussions will be presented in the talk.