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Fusions of 32,34S+112,116,120,124Sn: 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 subbarrier 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 32S+94,96Zr but not in 58,64Ni+118,124,132Sn 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 32,34S+112,116,120,124Sn 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, Qgg values vary from -2.08 MeV for 34S+112Sn to 5.63 MeV for 32S+124Sn. 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.

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