Fusion and neutron transfer of $^9\text{Be} + ^{169}\text{Tm}, ^{181}\text{Ta}$ and $^{187}\text{Re}$ at near-barrier energies


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Recently, great theoretical and experimental efforts have been devoted to the investigation of the behavior of fusion of weakly bound nuclei, both stable and radioactive [1, 2]. Such nuclei have low breakup energy threshold and the breakup process feeds states in the continuum. Particularly important in this field is the investigation of the effect of the breakup of the weakly bound nuclei on the fusion cross sections. Some measurements of fusion cross sections of the weakly bound $^9\text{Be}$ projectile on different targets have been reported [3, 4]. However, contrary to what was found for other weakly bound nuclei $^6,^7\text{Li}$, for which the complete fusion (CF) suppression at energies close the barrier is almost target independent [5–7], for the CF of $^9\text{Be}$ the suppression was found to vary with target from 10% to 40%. In order to contribute to the investigation of the dynamical effect of the breakup of $^9\text{Be}$ on fusion, we have performed experiments to measure the fusion and $1n$ transfer of $^9\text{Be}$ on the $^{169}\text{Tm}, ^{181}\text{Ta}$ and $^{187}\text{Re}$ targets at energies close to the Coulomb barrier.

The experiments have been performed at the sector focusing cyclotron in the Heavy Ion Research Facility Lanzhou (HIRFL). The activation technique with the detection of off-line gamma rays was used to derive the cross sections. Complete fusion suppression of the order of 30% was found for the three systems, at the energy range slightly above the Coulomb barrier. We investigated a possible systematic behavior of the suppression of complete fusion cross sections for different targets available in literature. We found that the suppression is roughly independent of the target. As the breakup should increase with the target mass or charge, we suppose that most of the breakup is of the delayed kind that can not affect fusion, whereas the prompt breakup effect on fusion does not depend on the target [8, 9].