Neutron transfer and breakup entrance channel effects on the Li+Sn fusion reactions

M. Fisichella[1,2], A. Shotter[3,4], A. Di Pietro[1], P. Figuera[1], M. Lattuada[1,5], C.Marchetta[1], A.Musumarra[1,5], M.G. Pellegriti[1,5], C.Ruiz[3], V. Scuderi[1,5], E.Strano[1,5], D.Torresi[1,5], M.Zadro[6]

[1]*INFN- Laboratori Nazionali del Sud and sezione di Catania, Catania, Italy*
[2]*Dipartimento di Fisica, Università di Messina, Messina, Italy*
[3]*TRIUMF, Vancouver, Canada*
[4]*School of Physics and Astronomy, University of Edinburgh, Edinburgh, UK*
[5]*Dipartimento di Fisica ed Astronomia, Università di Catania, Catania, Italy*
[6]*Ruđer Bošković Institute, Zagreb, Croatia*

Recently, we proposed to study fusion excitation function for the ^{6}Li+^{120}Sn, ^{7}Li+^{119}Sn, ^{8}Li+^{118}Sn and ^{9}Li+^{117}Sn systems, to investigate the possible influence of the different n-transfer Q-values in the four entrance channels on the sub-barrier fusion process. In the last years, in fact, an intense debate arose about the possible dependence of the sub-barrier fusion cross section on the sign of neutron transfer Q-value. However, so far, contradictory results have been reported in the literature [1-3]. In our case, the choice of the Li+Sn combination seems particularly suitable for this kind of studies since these reactions are characterised by very similar structures of the interacting nuclei, all lead to the same compound nucleus (^{126}I) but they present different Q-value for one- and two- neutron transfer. Thus, by the comparison of the sub-barrier fusion excitation functions for the four systems, it should be possible to evidence the possible effects due to the different entrance channel neutron transfer Q-values.

Moreover, since our projectiles are weakly bound nuclei, by comparing, at energies above the barrier, the complete fusion (CF) excitation function for each system with the predictions of the one dimensional penetration model (1DBPM), we can investigate the role played by the projectile breakup on the above-barrier fusion cross section. It has been observed that the break-up process affect the CF cross section in reaction induced on heavy targets, reducing the CF excitation function with respect to the 1DBPM predictions. Instead, in reactions on medium and light mass targets no reduction was observed in the CF. The present study extends the investigation of the possible relation between the suppression factor and the atomic number of the target in a mass range never investigated before.

In this contribution, the results concerning the study of the systems ^{6}Li+^{120}Sn and ^{7}Li+^{119}Sn, performed at the Laboratori Nazionali del Sud, Catania, will be presented and discussed. In these experiments the fusion cross section has been measured by using an improved target stack activation technique, which takes into account the effects that the target non-uniformity could generate in the determination of the fusion excitation function.

For both the studied reactions, at energies above the barrier, a suppression of the CF excitation functions has been observed, as in the case of the heavier targets. At sub-barriers energies, despite of the different Q-values in the entrance channels, no particular differences in the fusion excitation functions have been observed.

[1] Stefanini et al., Phys.Rev. C 74 034606 (2006)
[2] Zagrebaev et al., Phys. Rev. C 67 061601(R) (2003)
[3] Kohley et al., Phys. Rev. Lett. 107, 202701 (2011)
[4] Dasgupta et al. Phys. Rev. C, 70, 024606 (2004)