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EXPECTATIONS AND LIMITS TO SYNTHESIZE NUCLEI WITH $Z \geq 120$

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In order to explore the possibilities to synthesize the new superheavy elements with Z=120, 122, 124, 126 some hot-fusion (mass asymmetric) reactions and cold-fusion (less mass asymmetric) reactions are studied. The dynamics of reaction with massive nuclei and the formation probability of heavy and superheavy elements with Z=90-126 in the asymmetric and symmetric reactions are discussed. The systematics of fusion probability $P_{\rm CN}$ and evaporation residue cross section $\sigma_{\rm ER}$ in these reactions are presented. Moreover, we explore the possibility of synthesis of superheavy nuclei by the use of reaction with the neutron rich radioactive beam ^{132}Sn, and by symmetric reactions like ^{136}Xe+^{136}Xe and ^{139,149}La+ ^{139,149}La.

1. Introduction

Very recently the synthesis of heaviest elements 114, 116 and 118 by using the hot-fusion reactions[1,2] with actinide targets and of 110, 111, 112, and 113 by using the cold-fusion reactions[3,4,5] with lead and bismuth targets, respectively, have been reported. The cross section of the evaporation residue (ER) formation being a superheavy element is very small: some picobarns, or even some percents of picobarn at synthesis of element $Z=113$. In order to explore the possibility of synthesis of new elements with Z=120, 122, 124, 126 were thought some kinds of hot-fusion reactions (for example the ^{54}Cr+^{248}Cm, ^{54}Cr+^{249}Cf, ^{58}Fe+^{249}Cf, and ^{64}Ni+^{249}Cf reactions) or other kinds of cold-fusion reactions (for example the ^{132}Sn+^{174}Yb, ^{132}Sn+^{176}Hf, ^{132}Sn+^{186}W and ^{84}Kr+^{232}Th reactions) which could lead to the formation of nuclei in the Z=120-126 range. In the case of using cold-fusion reactions, and the use of neutron rich radioactive beam ^{132}Sn will be promising to synthesize superheavy elements by some nearly symmetric reactions, someone could be attempt of developing the dream to investigate some other symmetric reactions as ^{132}Sn+^{208}Pb and ^{132}Sn+^{249}Cf which should lead to the formation of the ^{340}132 and ^{382}148 superheavy elements, respectively. Moreover, various studies were conducted by many authors[6,7,9,10] on mass symmetric and asymmetric reactions (^{136}Xe+^{136}Xe, ^{149}La+^{149}La, ^{86}Kr+^{208}Pb, ^{58}Fe+^{244}Pu) estimating relevant or promising results for the fusion formation of superheavy elements, but in the conducted experiments no events were found.[11,12,13] Many laboratories are planning to perform experiments in such field of nuclear reactions and the present study can be useful in such complex context. Therefore, it is needed to investigate the conditions and limits of reactions with the aim to form compound nuclei (CN), and to observe evaporation residues of superheavy elements. There are three reasons causing a hindrance to the evaporation residue formation in the reactions with massive nuclei: the quasifission, fusion-fission, and fast fission processes.[14,15,16] The quasifission process competes with the fusion process during the evolution of the dinuclear system (DNS). This process occurs when the dinuclear system prefers to break down into fragments instead of to be transformed into fully equilibrated CN. The number of events going to quasifission increases drastically by increasing the sum of the Coulomb interaction and rotational energy in the entrance channel. Another reason decreasing yield of ER is the fission of a heated and rotating compound nucleus (CN) which is formed in competition with quasifission. The stability of a massive CN decreases due to the decrease of the fission barrier by increasing its excitation energy $E^*_{\rm CN}$ and angular momentum L. Because the stability of the transfermium nuclei are connected with the availability of shell correction in their binding energy which are sensitive to $E^*_{\rm CN}$ and values of the angular momentum. To find favorable reactions (projectile and target pair) and the optimal beam energy range leading to larger cross sections of synthesis of superheavy elements, we should establish conditions to increase as possible the events of ER formation.[14,15,16] Moreover, another reason decreasing yield of ER is the fast fission process which is the decay of the deformed mononucleus (surviving quasifission) into two fission-like fragments (binary fragments). So, the main channels decreasing the cross section of complete fusion are quasifission and fast fission. These channels produce binary fragments which can overlap with the ones with the fusion-fission channel and the amount of the mixed detected fragments depends on the mass asymmetry of entrance channel, beam energy, as well as the shell structure of being formed reaction fragments. Therefore, the experimental method to extract the fusion-fission contribution by the analysis of the mass and angular distributions of binary fragments of the full momentum transfer events is not unambiguous.

In Sect. 2 we present the model of reactions in heavy ion collisions. The calculations and systematics obtained on a wide set of reactions are presented in Sect. 3. In Sect. 4 are discussed the results of ER cross sections for the reactions leading to compound nuclei wit Z = 120-126. The conclusions are given in Sect. 5.

2. Model of Reactions

By using the DNS model,[17] the first stage of reaction is the capture formation of the dinuclear system after full momentum transfer of the relative motion of colliding nuclei into a rotating and excited system. In the deep inelastic collisions DNS is formed but the full momentum transfer does not occur. Therefore, the deep inelastic collisions are not capture reactions. In the capture reactions the colliding nuclei are trapped into the well of the nucleus-nucleus potential after dissipation of part of the initial relative kinetic energy and orbital angular momentum. Our model[14,15,16,18,19] takes into account the evolution of nuclei constituting the DNS and describes the competition between the quasifission and complete fusion processes during the second stage of reaction (with possible formation in some case of fast fission products too). The third stage of reaction is the formation of evaporation residues in competition with fusion-fission fragments following the de-excitation cascade of compound nucleus. Fig. 1 shows the scheme of reactions through the three above-mentioned stages.

According to the DNS model a capture event is the trapping of the collision path into the potential well (see Fig. 2) after dissipation of the sufficient part of the relative kinetic energy of a projectile nucleus in the center-of-mass coordinate system. Certainly the presence of a potential pocket and adequacy of the collision energy $E_{\rm c.m.}$ to overcome the interaction barrier (Coulomb barrier + rotational energy of the entrance channel) are necessary conditions to occur capture as shown in Fig. 2. Thus capture leads to forming dinuclear system which is characterized by mass (charge) asymmetry of its nuclei, rotational energy $V_{\rm rot}$ and excitation energy E^*_{DNS}. The relative energy of nuclei is relaxed, therefore, the total kinetic energy of fragments formed at its decay are close to the Viola systematics.[20] The study of dynamics of processes in heavy ion collisions at the near Coulomb barrier energies showed that complete fusion does not occurs immediately in the case of the massive nuclei collisions.[17,21,22,23]

The partial capture cross section at a given energy $E_{\rm c.m.}$ and orbital angular momentum ℓ is determined by the formula:

$$\sigma^{\ell}_{cap}(E_{\rm c.m.}) = \pi \lambda\!\!\!^{-2} \mathcal{P}^{\ell}_{cap}(E_{\rm c.m.}), \qquad (1)$$

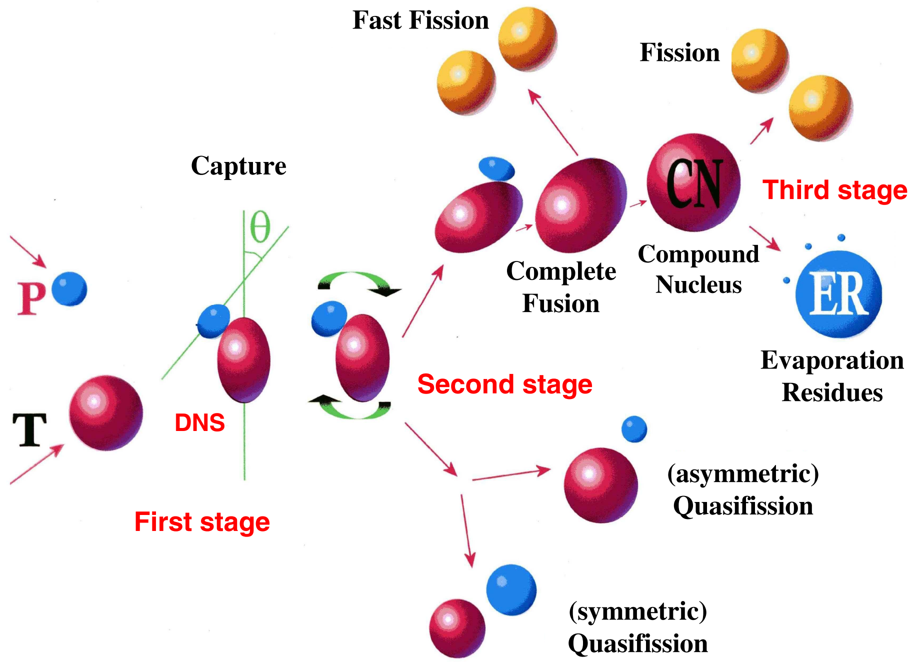

Fig. 1. Scheme of possible reactions in heavy ions collisions between projectile P and target T: i) stage of capture at formation of DNS; ii) stage of competition between quasifission and complete fusion (with possible contribution of fast fission); iii) stage of de-excitation cascade of compound nucleus (CN) with final products of evaporation residues (ER) and fusion-fission fragments.

where $\mathcal{P}^{\ell}_{cap}(E_{\rm c.m.})$ is the capture probability for the colliding nuclei to be trapped into the well of the nucleus-nucleus potential after dissipation of part of the initial relative kinetic energy and orbital angular momentum. The capture probability $\mathcal{P}^{\ell}_{cap}$ is equal to 1 or 0 for a given $E_{\rm c.m.}$ energy and orbital angular momentum ℓ. Our calculations showed that, depending on the center-of-mass system energy $E_{\rm c.m.}$, there is a "window" in the orbital angular momentum for capture with respect to the following conditions:[15,24]

$$\mathcal{P}^{\ell}_{cap}(E_{\rm c.m.}) = \begin{cases} 1, & \text{if} \quad \ell_{\rm min} \leq \ell \leq \ell_{\rm d} \quad \text{and} \quad E_{\rm c.m.} > V_{\rm Coul} \\ 0, & \text{if} \quad \ell < \ell_{\rm min} \quad \text{or} \quad \ell > \ell_{\rm d} \text{ and } \quad E_{\rm c.m.} > V_{\rm Coul} \\ 0, & \text{for all } \ell \quad \text{if} \quad E_{\rm c.m.} \leq V_{\rm Coul} \,. \end{cases}$$

The boundary values ℓ_{min} and ℓ_d of the partial waves leading to capture depend on the dynamics of collision and they are determined by solving the equations of motion for the relative distance R and orbital angular momentum ℓ.[23,25,26] At lower energies, ℓ_{min} decreases to zero and we do not observe the ℓ "window": $0 \leq \ell \leq \ell_d$. The range of the ℓ "window" is defined by the size of the potential well of the nucleus-nucleus potential $V(R, Z_1, Z_2)$ and the values of the radial γ_R and tangential γ_t friction coefficients, as well as by the moment of inertia for the relative

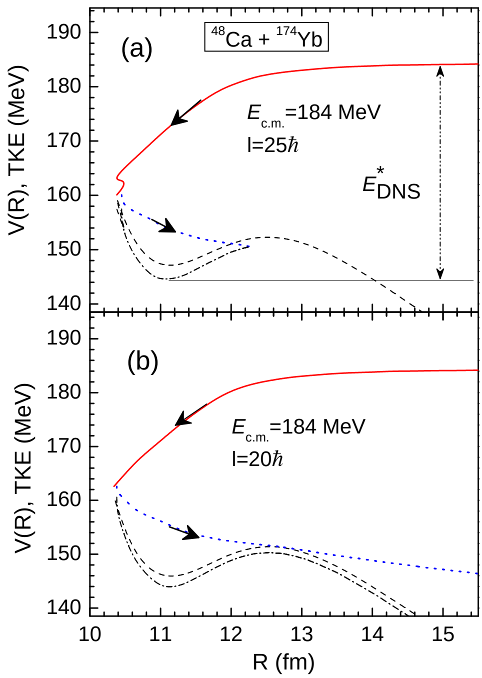

Fig. 2. The capture (a), and deep inelastic collisions (b), in the dinuclear system concept for the ^{48}Ca+^{174}Yb reaction at $E_{\text{c.m.}}$=184 MeV. The solid and dotted lines are total kinetic energy (TKE) of the ingoing and outgoing paths of collision, respectively. The dashed and dot-dashed lines are nucleus-nucleus potential ($V(R)$) for the ingoing and outgoing paths, respectively. E^*_{DNS} is the excitation energy of the dinuclear system formed at capture.

motion.[24,25] The capture cross section is determined by the number of partial waves that lead colliding nuclei to be trapped in the well of the nucleus-nucleus potential. The size of the potential well decreases with increasing orbital angular momentum ℓ. The value of ℓ at which the potential well disappears is defined as the critical value ℓ_{cr}. In some models, it is assumed to be the maximum value of the partial waves contributing to complete fusion. But, unfortunately, this is not true: the use of ℓ_{cr}, as a maximum value of ℓ contributing to capture, leads to the overestimation of the capture and fusion cross sections. This is because the deep inelastic collisions take place at $\ell_d < \ell \leq \ell_{cr}$. It should be stressed that such a process occurs because of the limited values of the radial friction coefficient.[25,27,28] Capture becomes impossible at low values of the orbital angular momentum if the beam energy values are higher than the Coulomb barrier.

The quasifission process competes with formation of complete fusion. This process occurs when the dinuclear system prefers to break down into fragments instead of to be transformed into fully equilibriated compound nucleus (CN). The number of events going to quasifission increases drastically by increasing the sum of the Coulomb interaction and rotational energy in the entrance channel.[15,25]

The lifetime of the DNS should be enough for its transformation into a compound nucleus during its evolution. The formation of the compound nucleus (CN) in reactions with massive nuclei has a hindrance: not all of the dinuclear systems formed at capture of the projectile by the target nucleus can be transformed into a CN. The decay of the DNS into two fragments bypassing the stage of the CN formation we call quasifission. Instead, the fast fission process is the inevitable decay of the fast rotating mononucleus into two fragments without reaching the equilibrium compact shape of a CN. Such a mononucleus is formed from the dinuclear system that survived against quasifission. At large values of the angular momentum $\ell > \ell_f$, where ℓ_f is a value of ℓ at which the fission barrier of the corresponding compound nucleus disappears, the mononucleus immediately decays into two fragments.[29] As distinct from fast-fission, the quasifission can occur at all values of ℓ at which capture occurs.

The fusion excitation function is determined by product of the partial capture cross section σ^{ℓ}_{cap} and the fusion probability P_{CN} of DNS at various $E_{\mathrm{c.m.}}$ values:

$$\sigma_{fus}(E_{\mathrm{c.m.}};\beta_P,\alpha_T) = \sum_{\ell=0}^{\ell_f}(2\ell+1)\sigma_{cap}(E_{\mathrm{c.m.}},\ell;\beta_P,\alpha_T)P_{CN}(E_{\mathrm{c.m.}},\ell;\beta_P,\alpha_T). \quad (2)$$

Obviously, the quasifission cross section is defined by

$$\sigma_{qfis}(E_{\mathrm{c.m.}};\beta_P,\alpha_T) = \sum_{\ell=0}^{\ell_d}(2\ell+1)\sigma_{cap}(E_{\mathrm{c.m.}},\ell;\beta_P,\alpha_T)(1-P_{CN}(E_{\mathrm{c.m.}},\ell;\beta_P,\alpha_T)). \quad (3)$$

For more specific details and descriptions on the model see Refs.[14,15,16,19,24].

The fast fission cross section is calculated by summing the contributions of the partial waves corresponding to the range $\ell_f \leq \ell \leq \ell_d$ leading to the formation of the mononucleus:

$$\sigma_{fastfis}(E_{\mathrm{c.m.}};\beta_P,\alpha_T) = \sum_{\ell_f}^{\ell_d}(2\ell+1)\sigma_{cap}(E_{\mathrm{c.m.}},\ell;\beta_P,\alpha_T)P_{CN}(E_{\mathrm{c.m.}},\ell;\beta_P,\alpha_T). \quad (4)$$

The capture cross section in the framework of the DNS model is equal to the sum of the quasifission, fusion-fission, and fast fission cross sections:

$$\begin{aligned}\sigma^{\ell}_{cap}(E_{\mathrm{c.m.}};\beta_P,\alpha_T) &= \sigma^{\ell}_{qfiss}(E_{\mathrm{c.m.}};\beta_P,\alpha_T) + \sigma^{\ell}_{fus}(E_{\mathrm{c.m.}};\beta_P,\alpha_T)\\ &\quad + \sigma^{\ell}_{fastfis}(E_{\mathrm{c.m.}};\beta_P,\alpha_T). \end{aligned} \quad (5)$$

It is clear that the fusion cross section includes the cross sections of evaporation residues and fusion-fission products. The fission cross section is calculated by the advanced statistical code[30,31,32] that takes into account the damping of the shell correction in the fission barrier as a function of nuclear temperature and orbital angular momentum.

$$\sigma_{ER(x)}(E^*_x) = \sum_{\ell=0}^{\ell_d}(2\ell+1)\sigma^{\ell}_{(x-1)}(E^*_x)W_{\mathrm{sur}(x-1)}(E^*_x,\ell), \quad (6)$$

Table 1. The listed reactions are reported as a function of the charge $Z_{\rm CN}$ of compound nucleus (if it can be reached), and the parameter $z = \frac{Z_1 \times Z_2}{A_1^{1/3}+A_2^{1/3}}$ representing the Coulomb barrier of reacting nuclei in the entrance channel.

Reaction	$Z_{\rm CN}$	$z = \frac{Z_1 \times Z_2}{A_1^{1/3}+A_2^{1/3}}$	Reaction	$Z_{\rm CN}$	$z = \frac{Z_1 \times Z_2}{A_1^{1/3}+A_2^{1/3}}$
^{96}Zr+^{124}Sn	90	209	^{48}Ca+^{248}Cm	116	194
^{96}Zr+^{132}Sn	90	207	^{48}Ca+^{248}Bk	117	196
^{86}Kr+^{136}Xe	90	204	^{48}Ca+^{249}Cf	118	198
^{48}Ca+^{174}Yb	90	152	^{86}Kr+^{208}Pb	118	286
^{32}S+^{182}W	90	134	^{132}Sn+^{174}Yb	120	328
^{40}Ar+^{181}Ta	91	145	^{64}Ni+^{238}U	120	253
^{32}S+^{208}Pb	98	144	^{58}Fe + ^{244}Pu	120	242
^{16}O+^{238}U	100	84	^{54}Cr + ^{248}Cm	120	229
^{48}Ca+^{208}Pb	102	172	^{132}Sn+^{176}Hf	122	337
^{50}Ti+^{208}Pb	104	188	^{54}Cr +^{249}Cf	122	234
^{136}Xe+^{136}Xe	108	284	^{132}Sn+^{186}W	124	343
^{58}Fe+^{208}Pb	108	218	^{58}Fe+^{249}Cf	124	251
^{48}Ca+^{226}Ra	108	181	^{84}Kr+^{232}Th	126	307
^{26}Mg+^{248}Cm	108	125	^{64}Ni+^{249}Cf	126	267
^{48}Ca+^{243}Am	115	193			

3. Calculations and Systematics for Heavy Ion Reactions

With the aim of comparing the results obtained for a wide set of reactions and to observe the trends of fusion and evaporation residue cross sections, we performed calculations of many reactions forming fissile compound nuclei with $Z \geq 90$ at the same excitation energy ($E^*_{\rm CN} \simeq 37$ MeV). In Table 1 we present the set of studied reactions leading to heavy and superheavy elements by various entrance channels with different charge (mass) asymmetry parameters.

It is interesting to observe and analyze the overall trend of the fusion probability $P_{\rm CN}$ and the evaporation residue yields for various reactions as a function of the charge Z of CN and of the parameter $z = \frac{Z_1 \times Z_2}{A_1^{1/3}+A_2^{1/3}}$ (related to the Coulomb barrier in the entrance channel) in order to draw some useful indications on the possible reactions leading to heavy nuclei with $Z \geq 90$ and particularly on reactions leading to superheavy elements with $Z \geq 120$.

Fig. 3 shows the fusion probability P_{CN} for the reactions listed in Table 1 as a function of the charge Z of CN, at excitation energy $E^*_{\rm CN} \simeq 37$ MeV. As one can see in this figure, $P_{\rm CN}$ slowly decreases with Z but strongly decreases for more symmetric reactions in entrance channel leading to the same $Z_{\rm CN}$. The trend of $P_{\rm CN}$ for the same investigation reactions appears more clear if we report the calculated $P_{\rm CN}$ as a function of the parameter $z = \frac{Z_1 \times Z_2}{A_1^{1/3}+A_2^{1/3}}$ representing the effect of the Coulomb barrier of interacting nuclei in the entrance channel.

The different symbols and values of $P_{\rm CN}$ reported at the same $Z_{\rm CN}$ (90, 108, 118, 120, 122, 122, 124, 126) represent different fusion probabilities for various entrance channels leading to the same $Z_{\rm CN}$. The $P_{\rm CN}$ values decrease for less asymmetric

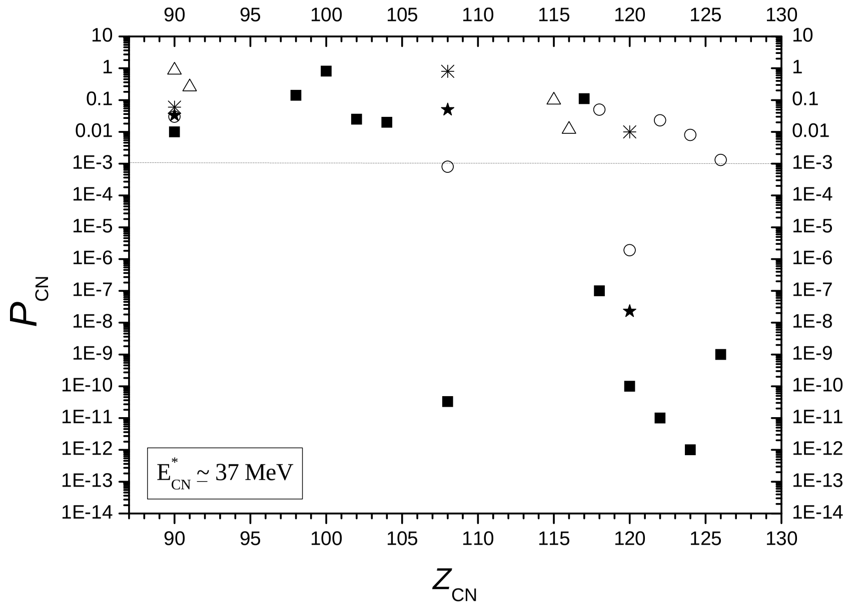

Fig. 3. Fusion probability $P_{\rm CN}$ versus charge $Z_{\rm CN}$, for the reactions listed in Table 1, calculated at the same excitation energy $E^*_{\rm CN} \simeq 37$ MeV.

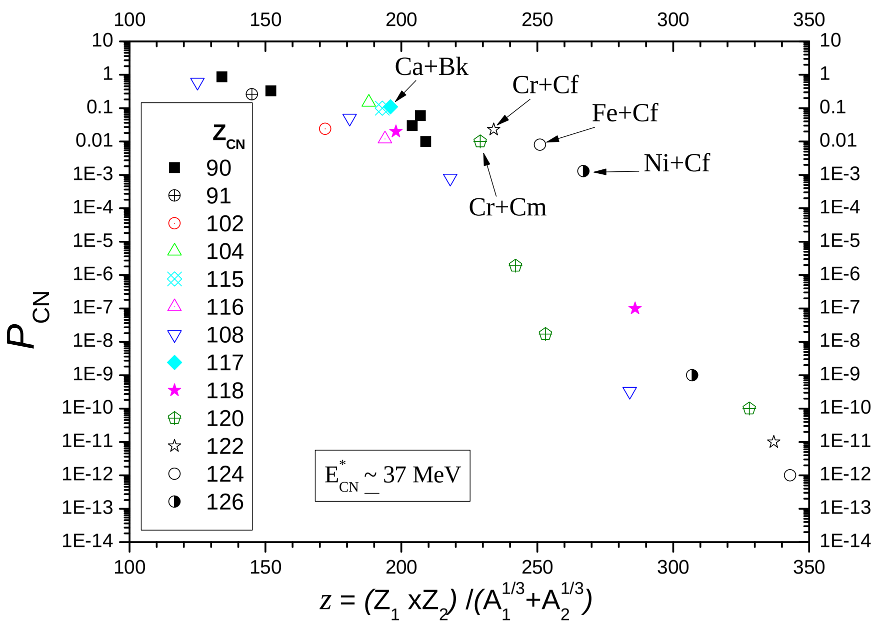

Fig. 4. Fusion probability $P_{\rm CN}$ versus the parameter z (representing the Coulomb barrier of reacting nuclei in the entrance channel) for many reactions with charge of compound nucleus $Z_{\rm CN}$ included in the $Z_{\rm CN}$ = 90-126 range.

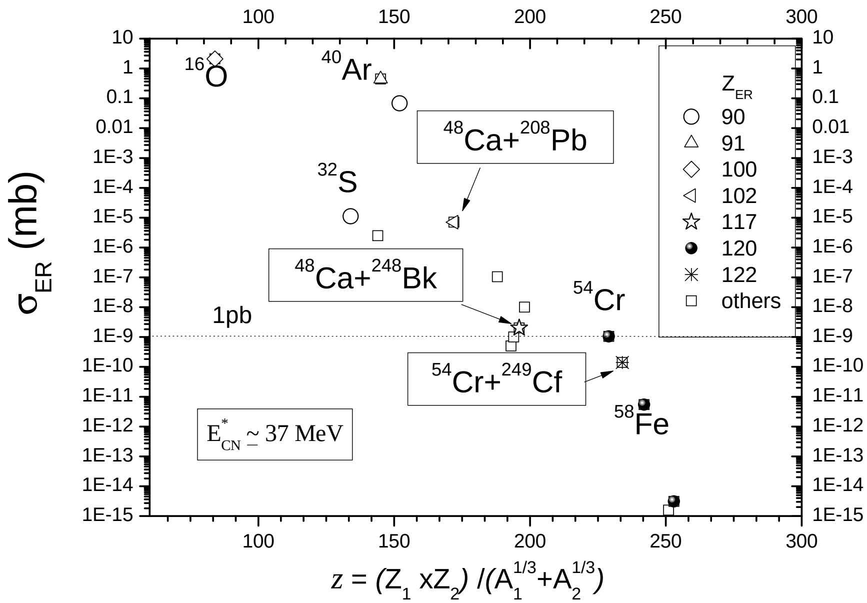

Fig. 5. Evaporation residue cross section $\sigma_{\rm ER}$ (after neutron emission only versus the parameter z representing the Coulomb barrier in the entrance channel, for reaction with ZCN= 90-120, at $E^*_{\rm CN} \simeq 37$ MeV.

reactions. As Fig. 4 shows the trend of $P_{\rm CN}$ at $E^*_{\rm CN} \simeq 37$ MeV strongly decreases with the increase of the z parameter and with the decrease of the charge (mass) asymmetry parameter of reactions in the entrance channel. The hindrance to fusion increases for more symmetric reactions and for higher Coulomb barriers of reactions in entrance channel.

Fig. 5 shows the evaporation residue cross sections, after neutron emission only from CN, obtained for the investigated reactions as a function of the parameter z, at $E^*_{\rm CN} \simeq 37$ MeV. In the figure the horizontal dotted line marks the value of 1 pb for the ER cross section. One can see that for reactions with parameter z lower than the value of about 200 it is possible to observe evaporation residues after neutron emission only from the de-excitation cascade of the compound nucleus. For reactions with values of parameter z included in the about 200-235 range the observation of residues is at limit (or it appears to be a very problematic task) of the current experimental possibilities. For reactions with z higher than 235 it is impossible to observe ER of CN after neutron emission only.

4. Reactions Leading to Compound Nuclei with $Z \geq 120$

We report in Table 2 the results obtained for the investigated reactions leading to CN with Z =120, 122, 124 and 126, at excitation energy of compound nuclei of about 37 MeV.

Fig. 6 shows the results of ER as a function of the parameter $z = \frac{Z_1 \times Z_2}{A_1^{1/3}+A_2^{1/3}}$, at $E^*_{\rm CN} \simeq 37$. In the figure is reported by dotted line the value of $\sigma_{\rm ER}$ of 1 pb. As one

Table 2. Reactions leading to compound nuclei with $Z_{\rm CN}$= 120-126, as a function of the parameter z representing the Coulomb barrier in the entrance channel. $\sigma_{\rm ER}$ is the ER cross section after the neutron emission only from the de-excitation cascade of CN; $P_{res/cap}$ is the ratio between the yields of evaporation residue $\sigma_{\rm ER}$ and the capture $\sigma_{\rm cap}$.

Reaction	$Z_{\rm CN}$	z parameter	$\sigma_{\rm ER}$ (mb)	$P_{res/cap}$
^{54}Cr + ^{248}Cm	120	229	1.05 × 10^{-9}	0.3 × 10^{-10}
^{58}Fe + ^{244}Pu	120	242	5.4 × 10^{-12}	0.17 × 10^{-13}
^{64}Ni+^{238}U	120	253	3.1 × 10^{-15}	0.14 × 10^{-15}
^{54}Cr +^{249}Cf	122	234	1.4 × 10^{-10}	0.13 × 10^{-11}
^{58}Fe+^{249}Cf	124	251	1.61 × 10^{-15}	0.18 × 10^{-16}
^{64}Ni+^{249}Cf	126	267	4.4 × 10^{-20}	6.5 × 10^{-22}

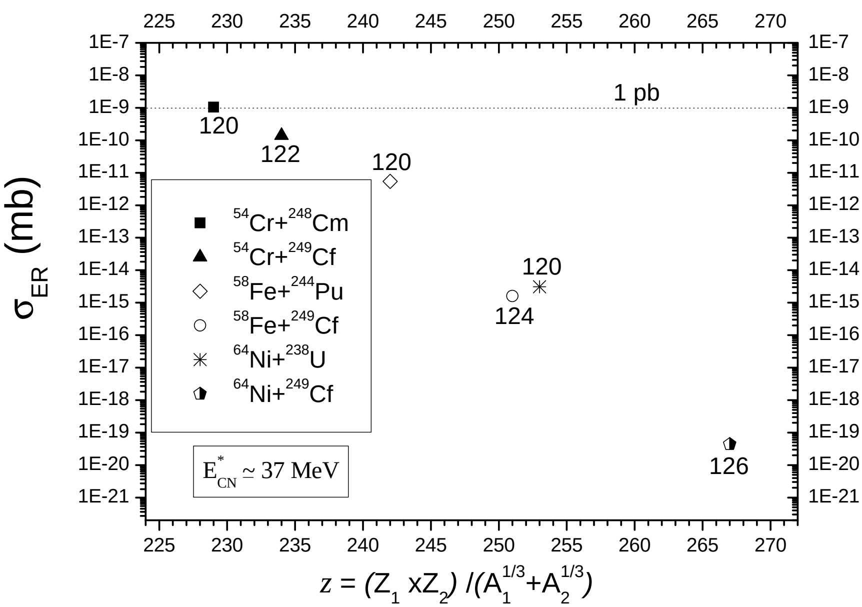

Fig. 6. As Fig. 5, but for reactions leading to $Z_{\rm CN}$= 120-126.

can see we estimate that only for the superheavy element with $Z = 120$ is possible to observe evaporation residues by reactions with z parameter lower than 230.

The observation of the superheavy element $Z = 122$ by reaction with z of about 234 appears to be a very doubtful venture.

The observation of superheavy elements with $Z = 124$ and 126 by reactions with z of about 251 and 267, respectively, is impossible by the current experimental conditions and detecting system of evaporation residues.

5. Conclusions

On the basis of dynamical calculations of reactions forming a dinuclear system in the entrance channel with subsequent evolution of DNS leading to competition of quasifission and complete fusion, and by the determination of reaction products obtained along the de-excitation cascade of compound nuclei, we studied for a wide set of reactions the distribution of the fusion probability $P_{\rm CN}$ versus charge Z of the compound nucleus, the systematics of $P_{\rm CN}$ versus the parameter z representing the Coulomb barrier in the entrance channel, the evaporation residue cross section $\sigma_{\rm ER}$ versus the z parameter. For ER obtained after neutron emission only from the de-excitaytion cascade of CN. From the study of such systematics it is possible to understand the role of the entrance channel mass symmetry on the fusion probability of reaction and the evaporation residue yields obtained in many reactions forming various compound nuclei at the same excitation energy $E^*_{\rm CN}$ of about 37 MeV.

The trend of $P_{\rm CN}$ is represented by a slow decrease with the increase of the charge Z of compound nucleus, by a relevant decrease of $P_{\rm CN}$ in respect of the symmetry parameter of the reaction entrance channel forming the same compound nucleus, and by a fast decrease of $P_{\rm CN}$ values and ER yields versus the parameter $z = \frac{Z_1 \times Z_2}{A_1^{1/3} + A_2^{1/3}}$.

At conclusion of the present investigation, the use of the neutron rich radioactive beam ^{132}Sn for the formation of superheavy nuclei is not of promising possibilities.

Regarding the results of the investigated reactions leading to the formation of compound nuclei with $Z = 120$, 122, 124 and 126, we affirm that it is possible to reach and observe the ER of the 120 superheavy element by a reaction with z parameter of about 230, while it is a very doubtful venture to synthesize the 122 superheavy element by reactions with z parameter of about 234 or higher by the current experimental resources and methods of observing evaporation residues.

It appears out of every possibility to observe evaporation residue of superheavy elements in reactions with z parameter in the entrance channel higher than 240. Therefore, it is impossible to form the 124 and 126 superheavy nuclei by the studied reactions above mentioned.

The quasifission is the main cause of hindrance of complete fusion and the yield of such a process strongly increases for reactions with higher z parameters and also with the increase of the $E^*_{\rm c.m.}$ energy. The fast fission and fusion-fission are the subsequent hindrances to lead to evaporation residues at forming of complete fusion and reaching of compound nucleus CN. In this context, the mass symmetric or nearly symmetric reactions in the entrance channels do not give a realistic possibility to synthesise superheavy elements, and the use of the ^{132}Sn beam is of scarce usefulness for this kind of reactions.

Consequently, it is an unrealizable dream to think of performing the ^{132}Sn+^{208}Pb (with $z = 373$) and ^{132}Sn+^{249}Cf (with $z = 431$) reactions in order to reach the ^{340}132 and ^{381}148 superheavy elements, respectively, and by mass symmetric reactions like ^{136}Xe+^{136}Xe (with $z = 184$) and ^{139,149}La+^{139,149}La (with z = 317 and 306, respectively) to synthesise heavy and superheavy elements to cause of the absolute dominant contribution of the quasifission process after capture, and the fast fission process presents at stage of the little probable formation of complete fusion.

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