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Original scientific paper

Study of the vaporization of LiI, LiI/C₇₀, LiI/LiF/C₇₀ from a Knudsen cell located in the ionization chamber of a mass spectrometer

JASMINA ĐUSTEBEK[#], MIOMIR VELJKOVIĆ[#] and SUZANA VELIČKOVIĆ^{*#}

*Vinča Institute of Nuclear Sciences, University of Belgrade, P. O. Box 522,
11001 Belgrade, Serbia*

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Abstract: The vaporization of LiI, LiI/C₇₀ and LiI/LiF/C₇₀ was studied using a Knudsen cell located in the ionization chamber of a magnetic sector mass spectrometer in the temperature range from 350 °C to 850 °C. The ion species, Li_nI⁺ ($n = 2, 3, 4$ or 6) were identified from the mixture LiI/C₇₀, while the clusters Li_nI⁺ and Li_nF⁺ ($n = 2, 3, 4, 5$ or 6) were detected from a mixture LiI/LiF/C₇₀. The intensities of Li_nI⁺ were higher than the emission of Li_nF⁺ cluster when the ratio of LiI to LiF was 2:1. By contrast, the emission of Li_nF⁺ is favored when the ratio of LiI to LiF was 1:2. These results show that the vaporization of a mixture LiI/LiF/C₇₀ from a Knudsen cell located in the ionization chamber of a mass spectrometer represents an efficient and simple way to obtain and investigate clusters of the type Li_nX, X = F or I. In this work, it was also shown that the trends of the I_n (Intensity, arb. units) *versus* temperature for all Li_nI⁺ clusters below and above the melting point of LiI were not same. This suggested that the manner of formation of these clusters could be different due to changes in temperature.

Keywords: “superalkali” species; Li_nI clusters; Li_nF clusters.

INTRODUCTION

A Knudsen cell with mass spectrometry (KCMS) has proven to be one of the most useful experimental techniques for investigation the equilibrium between condensed phases and complex vapor. The Knudsen effusion method involves placing a condensed sample in a Knudsen cell, with an orifice of well-defined geometry. The Knudsen cell is uniformly heated and held until equilibrium between the condensed and vapor phases is attained. The orifice dimensions must be kept less than one tenth of the mean free path of the vapor species. The vapor is continuously sampled by effusion through a small orifice in the cell. A mole-

* Corresponding author. E-mail: vsuzana@vinca.rs

Serbian Chemical Society member.

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cular beam is formed in the KCMS and directed into a mass spectrometer for identification.¹

The vaporization of alkali halides such as LiI and LiF by the KCMS method were investigated and discussed in terms of their vapor compositions in equilibrium with the condensed phases.^{2–6} As a result, Li^+ , LiX^+ , Li_2X^+ and Li_3X_2^+ ($\text{X} = \text{F}$ or I) ions were detected. The precursor of both Li^+ and LiX^+ was the monomer (LiX), whilst Li_2X^+ and Li_3X_2^+ were obtained from the dimer (Li_2X_2) and the trimer (Li_3X_3), respectively.

Since the salts of alkali metal are the strongest ion emitters, the KCMS method was also applied for investigations of their homogenous and heterogeneous clusters. Studies on metallic clusters are of considerable interest in research due to their potential application in catalytic processes, materials science, biology, and medicine.^{6–10} Especially, lithium homogenous clusters have received great attention from physicists and chemists as prototypes for the investigation of the properties of metallic clusters. The existence of stable Li_2 , Li_3 , Li_4 and Li_5 clusters was proved experimentally and their thermodynamic properties were determined by KCMS.^{11–13} The first “hypervalent” Li_3O cluster was also found by KCMS in the equilibrium vapor over Li_2O salt.¹⁴ This method was employed to obtain other small size “hypervalent” lithium clusters, such as Li_6C , Li_4O , Li_3S , Li_4S , Li_4P , Li_2CN , Li_nH ($n = 1, 2, 3$ or 4) in the equilibrium vapor over the appropriate salts.^{15–20} Generally, “hypervalent” species possess nine or more valence electrons and these clusters are of particular importance because they violate stoichiometry based on the octet rule.²¹ Due to their unusual stoichiometries, “hypervalent” clusters have large values of the first hyperpolarizabilities; therefore, they could be considered a new kind of non-linear optical species.²² In addition, earlier investigation revealed that these clusters are important intermediates in metal cluster and metal surface reactions, which could affect the catalytic and electronic properties of a metal.²³ The most remarkable property of “hypervalent” clusters is their enormously low ionization energy (IE). Their ionization energies are lower than the IE s of the alkali metals and for this reason, they are called “superalkali”.^{24–29} Recently, it was theoretically also shown that “superalkali” clusters are of great significance in chemistry because they can mimic the characteristics of alkali metals and maintain their structural and electronic integrities when assembled with other species. By combining “superalkali” with another element or clusters, a new small “superatom” clusters can be formed. The “superatom” clusters represent potential building blocks for new cluster-assembled materials with unique structural, electronic, optical, magnetic and thermodynamic properties.^{30–35} However, experimental results on “superalkali” clusters are scarce.

The present investigation is an extension of previous systematic studies of the way for obtaining “superalkali” clusters by the evaporation of lithium haloge-

nated salts using a thermal ionization source and a Knudsen cell in combination with a mass spectrometer.^{36–43} In the earlier papers, it was shown that the experimental setup in which the Knudsen cell was located in the ionization chamber provides better conditions than the standard experimental setup of the KCMS for obtaining both the neutral and positively charged “superalkali” clusters of the type Li_nX, X = F or I ($n = 2, 3, 4, 5$ or 6).^{40–43} However, the effects of the chemical composition of the samples which are placed in the Knudsen cell on the production of neutrals and positive ions of these clusters have not been investigated. The focus of this work was an investigation of the conditions for obtaining non-stoichiometric Li_nI and Li_nI_{n-1} clusters, from samples such as lithium iodide salt, a mixture lithium iodide/fullerene (C₇₀), a mixture of lithium iodide/lithium fluoride salt and a mixture lithium iodide/lithium fluoride/fullerene (C₇₀).

The relation between the intensity of the ions from the condensed phase and the temperature of the cell was also investigated.

EXPERIMENTAL

The standard experimental setup of the KCMS implies that the cell is placed outside the ionization chamber. In this work, the Knudsen cell was placed in the ionization chamber of a magnetic sector mass spectrometer (a 12-inch radius and 90° magnetic sector). The scheme for the ion source is presented in Fig. 1.

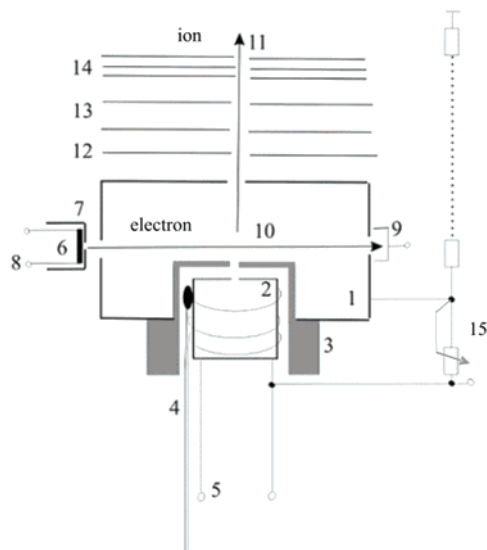


Fig. 1. Schematic diagram of the ion source: 1. ionization chamber; 2. Knudsen cell; 3. ceramic shields; 4. thermocouple; 5. heater for chamber; 6. incandescent rhenium cathode; 7. Vehnelt cylinder; 8. heater for cathode; 9. electron trap; 10. electron beam; 11. ion beam; 12. focusing electrode; 13. accelerating electrode; 14. deflectors electrode; 15. potential repeller.

The nickel Knudsen cell was heated with direct current through a tungsten wire. The height of the cell was 7 mm, the outside diameter was 6 mm and the orifice diameter was 0.1 mm. The heater was surrounded by a shield made of ceramic material. The temperature was

measured by a Pt–Pt/Rh thermo-couple attached to the cell. A cell temperature stability of ± 10 K was achieved.

The experimental setup presented in Fig. 1 allows the detection of both the ionic and neutral components. Neutral species were detected in the conventional way in the electron impact ionization (EI) mode. Electrons were obtained from a rhenium cathode inside a Vehnelt cylinder and extracted by a plate at a positive potential of 15 V with respect to the cathode that was positioned at a distance 2 mm from the cathode. The clusters, electron and ion beams were mutually perpendicular. In this case, the Knudsen cell was held at the same voltage as the ionization chamber. The Knudsen cell was placed in the ionization chamber; the distance from the cell orifice to the electron beam of the ion source was about 2 mm.

In the case when the Knudsen cell was held at voltage of 30 V with respect to the ionization chamber, the experimental setup permitted the direct identification of positively charged ionic components generated in the cell, thermal ionization (TI) mode.

In this work, the Knudsen cell was used as a chemical reactor for the production of the iodine-doped lithium clusters. In all experiments, the samples weighing 0.089 g were placed into the Knudsen cell at atmospheric pressure. The samples were lithium iodide salt, a mixture lithium iodide/fullerene (C_{70}), a mixture lithium iodide/lithium fluoride salt and a mixture of lithium iodide/lithium fluoride/fullerene (C_{70}). In order to remove the adsorbed moisture, the cell with the substance was dehydrated directly in the mass spectrometer at 150 °C for several hours.

In earlier work, it has been shown that in the vapor over a salt of lithium fluoride the ions Li_2F^+ (m/z 33) and $Li_3F_2^+$ (m/z 59) clusters were obtained.² Also, the ions as Li_2I^+ (m/z 141) and $Li_3I_2^+$ (m/z 276) were identified to be generated from the vapor of LiI.⁶ As can be observed, the peaks corresponding to the clusters of lithium fluoride were detected at lower mass than the mass of clusters of lithium iodide, for this reason, a salt LiF was used as an additional source of Li^+ .

RESULTS AND DISCUSSION

In the present work, as the first step, the vaporization of lithium iodide salt by the Knudsen cell located in the ionization chamber of the magnetic sector mass spectrometer over the temperature range from 350 to 600 °C was investigated. The temperature dependence of the natural logarithm of the ion intensity at an ionizing electron energy of 40 eV for all detectable ions is shown in Fig. 2. Similar curves were obtained for other electron energies, such as 20 and 30 eV.

The following ion species were detected: I^+ , I_2^+ , Li^+ , LiI^+ , $Li_2I_2^+$, Li_2I^+ , $Li_3I_2^+$ and $Li_4I_3^+$, which coincides well with previous results obtained using a standard KCMS.⁶ The results obtained in the present study are compared in Table I with those obtained by other researchers.

In the present case, the relative intensities of I^+ , I_2^+ , Li^+ , LiI^+ , $Li_2I_2^+$, $Li_3I_2^+$ and $Li_4I_3^+$ to the Li_2I^+ were much larger than the literature values.⁶ This indicates that the experimental setup in which the Knudsen cell is placed in the ionization chamber provides an efficient way to detect all of the above-mentioned ions.

In the second step, when a mixture LiI/ C_{70} was evaporated from the Knudsen cell and electron bombardment ionization was performed, the ions I^+ , I_2^+ ,

Li⁺, LiI⁺, Li₂I₂⁺, Li₂I⁺, Li₃I₂⁺, Li₄I₃⁺, Li₂I⁺, Li₃I⁺, Li₄I⁺ and Li₆I⁺ were observed. The natural logarithm of ion intensity as a function of temperature of the Knudsen cell for Li₂I⁺, Li₃I⁺, Li₄I⁺, and Li₆I⁺ are presented in Fig. 3. The ions I⁺, I₂⁺, Li⁺, LiI⁺, Li₂I₂⁺, Li₂I⁺, Li₃I₂⁺, Li₄I₃⁺ were detected at similar temperature ranges as in the case of LiI; for this reason, these ions are not shown in Fig. 3.

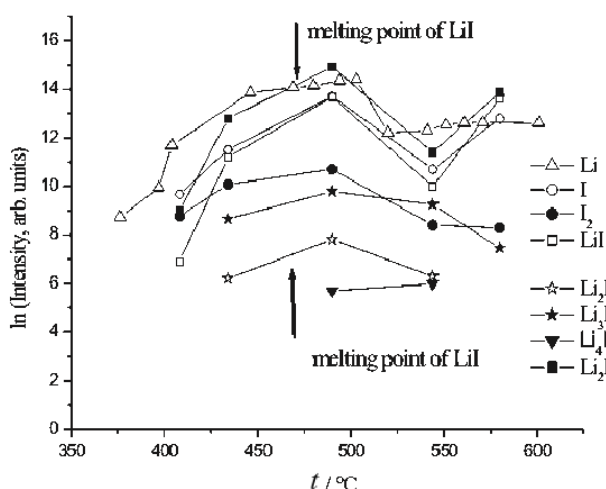


Fig. 2. The natural logarithm of the ion intensity as a function of the temperature of the Knudsen cell (\ln (Intensity, arb. units) versus temperature) for all detectable ions formed from the vapor over pure lithium iodide salt. These results were measured between 350 to 600 °C at 40 eV ionizing electron energy.

TABLE I. Comparison of results obtained in this work with those obtained previously⁶

Ion	Li ⁺	I ⁺	LiI ⁺	Li ₂ I ⁺	I ₂ ⁺	Li ₂ I ₂ ⁺	Li ₃ I ₂ ⁺	Li ₄ I ₃ ⁺	E / eV
Literature	16.41	6.99	42.8	100	0.95	0.72	1.67	0.19	30
This work	95.3	91.9	91.94	100	71.81	52.34	65.1	38.25	40

The threshold temperature for the start of the observation of ion signal was found to be about 355 °C for Li_nI⁺ ($n = 2, 3$ and 4) clusters (Fig. 3). Initially the ion intensity increased with temperature, then decreased after a maximum at about 395 °C for Li₃I⁺ and Li₄I⁺ clusters. Above 455 °C, the emission of Li₃I⁺ finally decreased to an undetectable level. The ion intensity of Li₄I⁺ clusters decreased to a minimum at about 455 °C, then slightly increased, and then slightly varied with temperature (from 469 to 657 °C). By contrast, the intensity of Li₂I⁺ increased to a maximum, had almost constant values in the temperature range from 467 to 593 °C and then decreased. The emission of this ion was not observed above 672 °C.

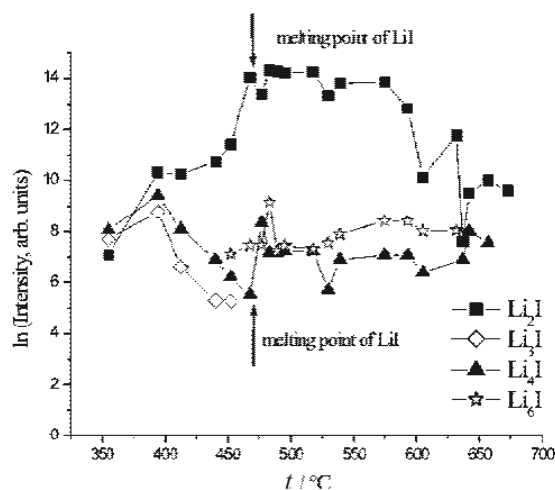


Fig. 3. The natural logarithm of the ion intensity as a function of the temperature of the Knudsen cell (\ln (Intensity, arb. units) versus temperature) for all detectable ions formed from the vapor over a mixture LiI/C_{70} . These results were measured from 350 to 600 °C at 40 eV ionizing electron energy.

The value of threshold temperature for observation of Li_6I^+ is lower than the temperature for the appearance of Li_nI^+ ($n = 2, 3$ and 4). The intensity vs. temperature for Li_6I^+ increases to a maximum at 485 °C, similar as with Li_2I^+ . The intensity of the Li_6I^+ cluster after the maximum, somewhat decreases and has almost constant value in the temperature range from 490 to 635 °C. As it can be seen in Fig. 3, the order of the intensities was $\text{Li}_2\text{I}^+ \gg \text{Li}_6\text{I}^+ > \text{Li}_4\text{I}^+$, while the Li_3I^+ cluster was not detected in the temperature range between 455 to 635 °C.

The earlier experimental study showed that Li_2I_2 , Li_3I_3 and Li_4I_4 could be precursors of Li_2I^+ , Li_3I_2^+ and Li_4I_3^+ , respectively.⁶ In the present work, it is difficult to assume exclusively precursors of Li_nI^+ ($n = 2, 3, 4$ and 6) clusters, based on the results presented in Fig. 3.

However, the presented results clearly show that the plot of the \ln (intensity, arb. units) versus temperature trends before and after the melting point of LiI (469 °C) do not correspond. At temperatures below the melting point of LiI , in a preliminary experiment, it was shown that the values of the ionization energies for Li_nI^+ ($n = 2, 3$ or 4) were much higher than their theoretical values. This fact implies that dimer, trimer, tetramer, Li_3I_2^+ , and Li_4I_3^+ could be precursors of Li_2I^+ , Li_3I^+ and Li_4I^+ , respectively. Therefore, the appearance energies of Li_nI^+ could be measured at temperatures below 469 °C. On the other hand, in a previous work, it was shown that the ionization energies of Li_nI^+ ($n = 2, 4$ and 6) could be determined at temperatures higher than 550 °C.⁴¹ These ionization

energies are in agreement with the *IEs* obtained by theoretical calculations, meaning that the precursors of Li_nI⁺ clusters were not the same as mentioned above.

This observation suggests that the shape of the *In* (intensity, arb. units) *versus* temperature curves are different possibly due to the dissimilarity in formation mechanisms of these clusters in the Knudsen cell, such as the thermal decomposition of the evaporation species at low temperatures and the reaction of Li⁺ with undecomposed LiI at high temperatures.

It should be mentioned that in previous studies, it was revealed that the clusters Li_nF⁺ (*n* = 2, 3, 4, 5 and 6) and Li_nI⁺ (*n* = 2, 4 and 6) were obtained in the vapor over a mixture of lithium fluoride and lithium iodide using the experimental setup presented in Fig. 1.^{40,42} For this reason, in step III, the evaporation mixtures LiI/LiF/C₇₀ from the Knudsen cell was studied. Both types of clusters, Li_nI⁺ and Li_nF⁺ (*n* = 2, 3, 4, 5 and 6), were obtained using a mixture LiI/LiF/C₇₀. If the ratio of LiI to LiF was 2:1, the signals of the Li_nI⁺ clusters were higher than those of the Li_nF⁺ clusters. By contrast, if the ratio of LiI to LiF was 1:2, signals of Li_nF⁺ in the mass spectrum were higher than those of Li_nI⁺. In this work, the Li_nF⁺ were not studied.

At temperatures below the melting point of lithium iodide, I⁺, I₂⁺, Li⁺, LiI⁺, Li₂I₂⁺, Li₃I₂⁺ and Li₄I₃⁺ were detected by the evaporation of a mixture LiI/LiF/C₇₀. In both cases, when a mixture LiI/LiF/C₇₀ or a mixture LiI/C₇₀ was evaporated, the *In* (Intensity, arb. units) *versus* temperature for Li_nI⁺ (*n* = 2, 3 and 4) had very similar trends. In addition, the intensities of all detectable ions obtained from a mixture LiI/LiF/C₇₀ were lower than the intensities of ions formed from a mixture LiI/C₇₀ before the melting point of LiI. This may be due to the simultaneous creation of Li_nI⁺ and Li_nF⁺ clusters from a mixture LiI/LiF/C₇₀, which did not occur during the evaporation of a mixture LiI/C₇₀. For this reason, the plots of the *In* (intensity, arb. units) *versus* temperature of the Li_nI⁺ cluster presented in Fig. 4 were obtained at temperatures above 460 °C.

Figure 4, part A, illustrates the variation of the *In* (intensity, arb. units) *versus* temperature for the ion clusters of the type Li_nI⁺ obtained by electron impact ionization. In Fig. 4, part B, the plots of the *In* (intensity, arb. units) *versus* temperature for Li_nI⁺, obtained by thermal ionization in the Knudsen cell at temperatures above 835 °C, are shown. As can be seen in part B of Fig. 4, the Li_nI⁺ (*n* = 2, 4, 5, and 6) clusters could be detected using the TI mode at temperatures higher than the melting point of LiF, while the Li₃I⁺ ion was not detected by the thermal ionization.

From Fig. 4, part A, it can be seen that the intensity of Li₂I⁺ and Li₄I⁺ increased from 468 to 616 °C and have almost constant value in the temperature range 616 to 782 °C. The intensity of Li₂I⁺ decreased above 782 °C, while a decrease in the intensity for Li₄I⁺ was not detected. The intensity *versus* temperature curve for Li₃I⁺ and Li₅I⁺ had almost constant values in the temperature

range presented in Fig. 4. As can be seen, the order of the intensities was $\text{Li}_2\text{I}^+ > \text{Li}_6\text{I}^+$ or $\text{Li}_4\text{I}^+ > \text{Li}_5\text{I}^+ > \text{Li}_3\text{I}^+$ at temperatures between 600 and 830 °C. This result showed that the intensities of Li_nI^+ increase when a salt LiF was added to a mixture LiI/C₇₀.

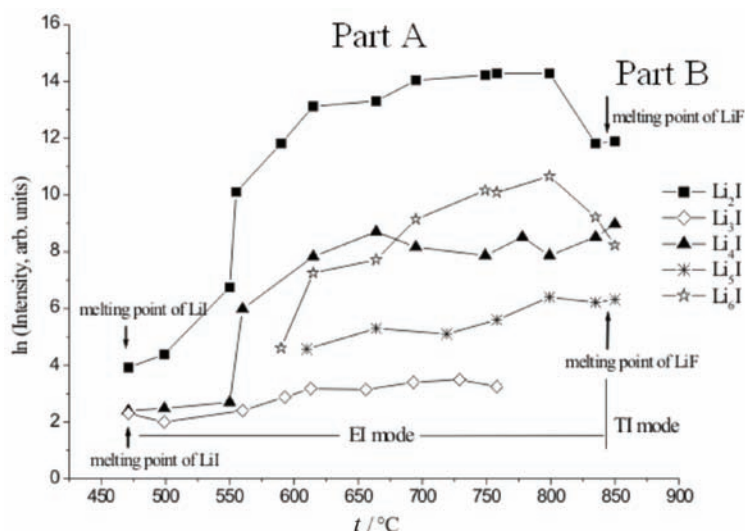


Fig. 4. Plots of \ln (Intensity, arb. units) versus temperature. The ions Li_nI ($n = 2, 3, 4, 5$ or 6) clusters were obtained in the electron impact mode (the temperature range of the Knudsen cell was 420 to 830 °C) and the positively charged clusters Li_nI^+ ($n = 2, 4, 5$ and 6) were generated in the Knudsen cell by thermal ionization (the temperature of the Knudsen cell was higher than 830 °C).

However, it should be noted that the Li_3I^+ and Li_5I^+ clusters were not detected from a mixture LiI/LiF.⁴⁰ In addition, the \ln (Intensity, arb. units) versus temperature trend for the mixture LiI/LiF did not correspond to the trend for the mixture LiI/LiF/C₇₀.⁴⁰ This implies that the presence of both C₇₀ and LiF provides optimal conditions for obtaining ions Li_nI^+ $n = 2, 3, 4, 5$ and 6 . Namely, in an earlier experiment, it has been shown that the solid-state reactions of fullerenes with various metal fluorides can be performed in a Knudsen cell. For example, the mass spectra recorded during the KCMS fluorination of C₇₀ with MnF₃ contained C₇₀F₃₆, C₇₀F₃₈ and C₇₀F₄₀.⁴⁴ Furthermore, the reaction of fluorination of C₇₀ is more efficient than the reaction of fullerene with lithium.⁴⁵ These facts suggest that the enhanced stability of Li_n^+ may be related to the presence of an additional Li source that remains in the Knudsen cell because the fluorine atom prefers a strong ionic bond with C₇₀. From another viewpoint, the fullerene C₇₀ could form a graphite monolayer on the inner surface of the Knudsen cell at higher temperatures. Generally, the existence of a graphite monolayer decreases the thermal dissociation of the clusters.⁴⁶

For clarity, the ions obtained by evaporation from pure LiI, a mixture LiI/C₇₀, and a mixture LiI/LiF/C₇₀, in the temperature range derived from the curves in Figs. 2 and 3, are summarized in Table II.

TABLE II. The ions obtained by the evaporation from pure LiI, from a mixture of LiI/C₇₀ and from a mixture of LiI/LiF/C₇₀, and the temperature range of the Knudsen cell

Sample	Ions	Ions of the type Li _n I ⁺	Temperature range, °C
LiI	I ⁺ , I ₂ ⁺ , Li ⁺ , LiI ⁺ , Li ₂ I ₂ ⁺ , Li ₃ I ₂ ⁺ , Li ₄ I ₃ ⁺	Li ₂ I ⁺	408–581
LiI/C ₇₀	I ⁺ , I ₂ ⁺ , Li ⁺ , LiI ⁺ , Li ₂ I ₂ ⁺ , Li ₃ I ₂ ⁺ , Li ₄ I ₃ ⁺	Li ₂ I ⁺ , Li ₃ I ⁺ , Li ₄ I ⁺ , Li ₆ I ⁺	355–673 355–453 355–658 452–632
LiI/LiF/C ₇₀	I ⁺ , I ₂ ⁺ , Li ⁺ , LiI ⁺ , Li ₂ I ₂ ⁺ , Li ₃ I ₂ ⁺ , Li ₄ I ₃ ⁺	Li ₂ I ⁺ , Li ₃ I ⁺ , Li ₄ I ⁺ , Li ₅ I ⁺ , Li ₆ I ⁺	355–837 355–758 355–835 609–837 452–833

Comparing data in the Table II, a few general trends can be noted. First, the fullerene C₇₀ provide a wider temperature range for the detection of Li_nI⁺ clusters. Second, the addition of the salt LiF to a mixture LiI/C₇₀ leads to an increase in the temperature range for the observation of these ions. This suggests that the formation of cluster ions is favored when the extra sources of lithium ions were present in the Knudsen cell.

CONCLUSIONS

In this work, the evaporation of LiI, LiI/C₇₀ and LiI/LiF/C₇₀ from a Knudsen cell located in the ionization chamber of a magnetic sector mass spectrometer was studied. The following ion species were detected: I⁺, I₂⁺, Li⁺, LiI⁺, Li₂I₂⁺, Li₃I₂⁺, Li₄I₃⁺ and Li_nI⁺ ($n > 2$). In all of three cases, the intensities of these ions *versus* temperature of the Knudsen cell were measured. The principal results were as follows:

1. The results indicate that the experimental setup where the Knudsen cell was placed in the ionization chamber provided abundances of all the detectable ions higher than did those obtained with a standard KCMS.
2. By evaporation of the mixture LiI/C₇₀, ions of Li_nI ($n = 2, 3, 4$ and 6) clusters were obtained, while evaporation of the mixture LiI/LiF/C₇₀ gave positive ions of Li_nI ($n = 2, 3, 4, 5$ and 6). The presence of both C₇₀ and LiF provides optimal conditions for obtaining Li_nI⁺ ($n = 2, 3, 4, 5$ and 6).
3. In all three cases, the most intensive peaks in the spectra were Li₂I⁺. The clusters with an even number of lithium atoms (Li₂I⁺, Li₄I⁺, Li₆I⁺) were more stable than the clusters with an odd number of lithium atoms (Li₃I⁺ and Li₅I⁺).

4. Trends of the plot I_n (Intensity, arb. units) *versus* temperature for Li_nI^+ cluster before and after the melting point of LiI do not correspond. It suggests that way of formation of these clusters could be different due to changes in the temperature. At temperatures below the melting point of lithium iodide, the dissociative ionization of $(\text{LiI})_2$, $(\text{LiI})_3$, $(\text{LiI})_4$, Li_3I_2^+ , and Li_4I_3^+ could be responsible for the generation of Li_2I^+ , Li_3I^+ and Li_4I^+ , respectively. Unfortunately, based on all the detectable ions, the predominant emission mechanism could not be experimentally determined at temperature higher than the melting point of lithium iodide.

5. The clusters Li_nI and Li_nF were obtained by evaporation of the mixture LiI/LiF/ C_{70} . The intensities of Li_nI clusters were higher than the emission of Li_nF cluster when the ratio of LiI to LiF was 2:1. In contrast, the emission of Li_nF clusters was enhanced, while the emission of Li_nI clusters was suppressed when the ratio of LiI to LiF was 1:2.

It could be concluded that a Knudsen cell located in the ionization chamber of a mass spectrometer provides an appropriate way to obtain and investigate clusters of the type Li_nX , X = F or I.

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ИЗВОД

ИСПИТИВАЊЕ ОТПАРАВАЊА LiI, LiI/ C_{70} И LiI/LiF/ C_{70} ИЗ КНУДСЕНОВЕ ЋЕЛИЈЕ СМЕШТЕНЕ У ЈОНИЗАЦИОНУ КОМОРУ МАСЕНОГ СПЕКТРОМЕТРА

ЈАСМИНА БУСТЕБЕК, МИОМИР ВЕЉКОВИЋ И СУЗАНА ВЕЛИЧКОВИЋ

Институт за нуклеарне науке Винча, Универзитет у Београду, Поштански фах 522, 11001, Београд

Отпаравање LiI, LiI/ C_{70} и LiI/LiF/ C_{70} је испитивано помоћу Кнудсенове ћелије, која је смештена у јонизациону комору магнетног масеног спектрометра, у температурском опсегу од 350 до 850 °C. Li_nI^+ ($n = 2, 3, 4$ и 6) врсте су детектоване из смеше LiI/ C_{70} , а кластери Li_nI^+ и Li_nF^+ ($n = 2$ до 6) су детектовани испаравањем смеше LiI/LiF/ C_{70} . Интензитет Li_nI^+ био је већи од интензитета Li_nF^+ кластера када је однос LiI и LiF био 2:1. С друге стране, стварање Li_nF^+ кластера је фаворизовано када је однос LiI и LiF био 1:2. Резултати показују да отпаравање смеше LiI/LiF/ C_{70} из Кнудсенове ћелије, која је смештена у јонизациону комору масеног спектрометра, представља ефикасан и једноставан начин за добијање и испитивање кластера типа Li_nX , X = F или I. У овом раду такође је показано да се зависност природног логаритма интензитета Li_nI^+ кластера од температуре разликује на температурама пре и после тачке топљења LiI. Ово указује на то да начин формирања наведених кластера може бити различит услед промене температуре.

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