study of noncongruent phase transitions in coulomb systems based on the MODIFIED model of binary ionic mixture

N.E. Stroev and I.L. Iosilevskiy

Joint Institute for High Temperature, Russian Academy of Sciences, Moscow, Russia, [nikita.stroev@phystech.edu](mailto:nikita.stroev@phystech.edu), [iosilevskiy@gmail.com](mailto:iosilevskiy@gmail.com)

A model of Coulomb noncongruent phase transition (NCPT) gas-liquid type with an upper critical point in modified model with no associations [1,2] of a binary ionic mixture (BIM ) on a homogeneous compressible ideal background (or non-ideal) electron gas was built in this work/ BIM (~)/. Ichimaru approximation was used for describing the electron-electron corellations [4], The analytical approximation (EoS) of Potekhin and Chabrier [3] was used for describing the ion-ion and ion-electron correlations. The "linear mixture" approximation (LM - Linear Mixing Rule). was used for mixture properties. Phase equilibrium for the charged components was calculated according to the Gibbs-Guggenheim conditions [1], the equality of generalized electrochemical potentials.

Because of the taken simplifications the series of calculations have been done with different sets of correlations for equilibrium values. The detail features of the realization of noncongruent equilibrium in comparison with the simpler (standard) forced-congruent evaporation mode were traced. The phase diagrams were built in *Р–Т–X* coordinates with their different cross sections, including two-dimensional ("banana-like") structures of two-phase region *Р–Т*. The characteristic nonmonotonic shape of caloric phase enthalpy-temperature diagram, similar to those obtained previously in the calculations of the noncongruent evaporation of reactive plasma products in high-temperature heating with the uranium-oxygen system [5] was also shown. The parameters of critical points (CT) line were calculated on the entire range of proportions of ions 0 < *х* < 1 in different equilibrium modes, including two reference values, when CT of noncongruent evaporation coincides with two "end" points on the boundary of the two-phase region - a point of extreme temperature and extreme pressure, *хТ* and *хР*. The absence of azeotropic features was also shown in this work, and it is clearly demonstrated the low-temperature property of noncongruent gas-liquid transition - "distillation" , which is weak in chemically reactive plasmas [5-6], and in contrast, is clearly seen in the exotic realization of noncongruent transition in superdense nuclear matter [7].

References

1. Iosilevskiy I. Thermodynamics of non-ideal plasmas, in: “Encyclopedia of Low-Temperature Plasma Physics” (Suppl. B, V.III-1), Eds. A.Starostin and I.Iosilevskiy, Moscow: Fizmatlit, 2004, PP.349-428 (in Russian)
2. Iosilevskiy I., High Temperature **23**, 807 (1985) [arXiv:0901.3535](http://xxx.lanl.gov/abs/0901.3535)
3. Ichimaru S., Iyetomi H., and Tanaka S., Phys. Rep. **149**, 91 (1987).
4. Potekhin A.Y., Chabrier G. Phys. Rev. **E** **62,** 8554 (2000) // **E** **79**, 016411 (2009)
5. Iosilevskiy I., Hyland G., Yakub E., Ronchi C. Int. Journ. Thermophys. **22,** 1253 (2001)
6. Iosilevskiy I., Gryaznov V., et al. Bulletin Russ. Acad. Sci. (Izvestia RAS), N **5**, 115 (2011)
7. Hempel M., Dexheimer V., Schramm S., Iosilevskiy I., Phys. Rev. C **88**, 014906 (2013)