Non-congruent phase transitions in PLASMAS OF COSMIC AND TERRESTRIAL APPLICATIONS

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Non-congruent (or *incongruent*) phase transitions (NCPT) are under discussion as the most general type of phase transformations in plasmas of chemical mixtures or compounds. The key role of Gibbs-Guggenheim conditions for correct description of non-congruence is stressed. It means equality for generalized electro-chemical potentials for all charged species in coexisting phases. Importance of (non-equal a priori) average electrostatic potentials in coexisting phases and corresponding potential drop (so-called Galvani potential) and its correlation with parameters of non-congruence is emphasized. Several examples of NCPT in Coulomb systems are discussed in comparison with well studied non-congruent evaporation chemically reactive plasma of products for high-temperature (extreme) heating of uranium dioxide, basic material for nuclear reactor safety problem [1-3]. Next, gas-liquid phase transition with upper critical point is considered as a prototype for non-congruent evaporation in metallic alloys. The base is modified non-associative Coulomb model of binary ionic mixture on uniformly compressible compensating background of non-ideal electron gas /BIM(~)/ [4]. Non-congruence of hypothetical “plasma” (PPT [5, 6] etc.) and “dissociative” (DPT [7, 8] etc.) phase transitions is also discussed as applied to the problem of interiors for Jupiter and Saturn, Brown Dwarfs and Extrasolar Planets. Next example is non-congruent gas-liquid transition in partially ionizes high-temperature silica (SiO2), that is important in many terrestrial and planetary applications [9]. Correlation of electrostatic features of phase interface with parameters of hypothetical non-congruence is discussed in application to phase transitions in highly asymmetric dusty and colloid plasmas [10]. Finally, the most exotic examples of non-congruent phase transitions one meets in the case of nuclear matter of ultra-high mass and energy densities. It is gas-liquid-like phase transition in ultra-dense plasmas of protons, neutrons and nuclei, and so-called quark-hadron (deconfinement) phase transition from hadronic matter into quark-gluon plasmas [11, 12].

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