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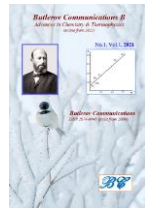

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# Properties of francium in atomic and condensed states in interpretation and estimates

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## Abstract

Since the classic study by Slater (1930), the atomic and cohesive characteristics of metals have been studied in relation to electronic properties, such as the effective charge of the atomic nucleus. The latter is relatively poorly defined in reference sources, where its significant scatter is observed. In this work, we do not use it.

The article analyzes the features that distinguish a relatively poorly studied chemical element – francium – from other alkali metals (AM). The presented approach makes it possible to take account examples of violation of the periodicity of the properties of the $_{87}Fr$ in a set of a AM depending on serial number of this element. Effective parameter of a forming electron with a core normalized by the ionization potential of the alkali metal atom has used as a descriptor for the purpose of the indicated properties (atomic and assumed compact substance) and for obtaining reliable estimates of their values. In contrast to the well-known receptions of the first ionization energies, the proposed calculation procedure, in its essence, does not rely on the traditional simplified concept of the hydrogen-like nature of the Coulomb component of the potential energy.

It is shown that all the considered characteristics can be expressed by an empirically simple power function of this parameter, which is immanent for a chemical element. These characteristics include the amplitude of the solution to the wave equation, static dipole polarizability, electron affinity, and gap width in the atomic spectrum. Values of electronegativity and effective atomic radius are refined on the basis of the developed approach as applied to *Fr*, and also estimates of the electron work function and sublimation heat, bond energy and radius of the spherical Wigner-Seitz cell are given. Arguments which allow us to consider the results of determining the radius of the francium neutral atom to be optimal are presented.

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