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CHEMICAL PROPERTIES OF ELEMENTS UNDER HIGH PRESSURE. INNOVATIONS IN THE ELECTRONEGATIVITY RANGE OF CHEMICAL ELEMENTS

Electronegativity is "the power of an atom in a molecule to attract electrons to itself" as described by Linus Pauling, the famous American chemist. It's used in a large number of chemical and physical tests and projects. Everyone learns the electronegativity range in school. Although this range is widely used, there is no defined specific range that everyone agrees on.

There are more than 20 different interpretations of electronegativity table, each using a different calculation method. In 2022 Xiao Dong from Nankai University together with Artem Oganov calculated electronegativity for chemical elements at high pressures and achieved potentially world changing results.

The scientists took Pauling's range for the base as it is most widely used in thermochemistry. His method of identifying ranges in the form of formulas is

$$D_{AB} = D_{AB}^{cov} + \Delta X_{AB}^2,$$

where D_{AB} is the dissociation energy of a single chemical bond between two different atoms A and B , D_{AB}^{cov} is the covalent part of that dissociation energy, X is electronegativity of element.

From here Dong and Oganov applied high pressure of 500 thousand, 2 million and 5 million atmospheres. Trying to apply Pauling's formula they found inconsistencies and in result came to change his theory.

$$D_{AB} = D_{AB}^{cov} \cdot (1 + \Delta X_{AB}^2),$$

Using the newly discovered formula, the scientists obtained new trends for the entire periodic table, while not encountering the problems that Pauling's formula provided. "Here we re-evaluate the concept of electronegativity... We identify the drawbacks in the definition of Pauling's electronegativity scale and reformulate our thermochemical scale based on experimental dissociation energies." - Quote from their published research.

The new scale improves the concept of thermochemistry of molecules and chemical reactions, and with future improvements and developments may result in new benchmarks for electronegativity ranges, while creating opportunities to create new types of chemical reactions.